Modelling User Satisfaction with Transportation Public-Private Partnership Projects

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ABSTRACT

The Build-Operate-Transfer (BOT) approach to infrastructure delivery has become famous as a crucial route for Public-Private Partnership (PPP) transportation infrastructure development in developing countries around the world including Thailand. One interesting PPP project is the Bangkok Mass Transit System (BTS) SkyTrain under a concession agreement with the Bangkok Metropolitan Administration (BMA). Another interesting project is the Second Stage Expressway operating under a concession granted by the Expressway Authority of Thailand (EXAT).

Due to the commercial nature of infrastructure projects adopting the BOT method, the satisfaction of users and officials is a key concern since they are principal PPP stakeholders. In order to assess the levels of satisfaction with PPPs, it is essential to study the levels of perceived satisfaction by key stakeholders. The focus of this study is to identify and evaluate the benefits associated with PPP projects in Thailand and to develop a model of user satisfaction with the two PPP projects. The research analysed, reviewed, and modelled user satisfaction on the BTS project. The model is then tested on the EXAT project.

Questionnaire survey responses from 561 EXAT users and 52 EXAT officials were obtained and analysed using the Statistical Package for Social Sciences (SPSS). Linear Structural RELationships (LISREL) is used to analyse the hypothesised user satisfaction model. The results show that three principal factors (Service, Safety, and Operation) correspond to Service Quality (SQ) and SQ affects Behaviour Intentions (BI) via Perceived Value (PV) and/or Satisfaction (SA). The verified and validated model is generated and developed by using the data from the BTS and EXAT projects.

DEDICATED

To

The One and Only True GOD

My people who have been my encouragers and life-long inspiration

The Love of My Life, My Soulmate and Wife

and

My Beloved Families and Friends

MAY THIS BE A USEFUL TOOL TO ALL WHO READ IT.

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DECLARATION STATEMENT

(Research Thesis Submission Form should be placed here)

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LIST OF ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AIAA	American Institute of Aeronautics and Astronautics
ANOVA	ANalysis Of VAriance
APA	American Psychological Association
BI	Behavioural Intentions
BLT	Build–Lease–Transfer
BOO	Build–Own–Operate
BOOT	Build–Own–Operate–Transfer
BOT	Build–Operate–Transfer
BMA	Bangkok Metropolitan Administration
BMCL	Bangkok Metro Public Company Limited
BROT	Build-Rehabilitate-Operate-Transfer
BTO	Build-Transfer-Operate
BTS	Bangkok Mass Transit System; BTS SkyTrain
BTSC	Bangkok Mass Transit System Public Company Limited
CCTV	Closed-Circuit Television
CITC	Corrected Item-Total Correlation
CEM	Construction Engineering Management
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CLD	Causal Loop Diagram
COE	Council of Engineers
CR	Composite Reliability or Construct Reliability
CS	Customer Satisfaction
DB	Design – Build
DBFO	Design – Build – Finance – Operate
DOH	Department of Highways
DMT	Don Muang Tollway Public Company Limited
EGIS	School of Energy, Geoscience, Infrastructure and Society
EXAT	Expressway Authority of Thailand
H-W U	Heriot-Watt University
IOC	Index of Item-Objective Congruence; Item-Objective Congruence Index

ISO	International Organisation for Standardisation
IT	Information Technology
ITS	Intelligent Transportation Systems
KM	Kilometre
LANL	Los Alamos National Laboratory
LISREL	LInear Structural RELationships
M	Mean; Arithmetic Mean (in mathematics and statistics)
MOT	Ministry of Transport
MRT	Mass Rapid Transit
MRTA	Mass Rapid Transit Authority of Thailand MRTA
NFI	Normed Fit Index
O&M	Operations and Maintenance
OEA	Office of Educational Affairs
OCSC	Office of the Civil Service Commission
PFI	Private Financed Initiative
PPP	Public-Private Partnership
PSP	Private Sector Participation
PR	Perceived Risk
PV	Perceived Value
QC	Quality Control
R&D	Research and Development
RFI	Relative Fit Index
RMSEA	Root Mean Square Error of Approximation
SA	Satisfaction
SBE	School of the Built Environment
SD	Standard Deviation
SD	System Dynamics
SEM	Structural Equation Modelling
SERVQUAL	Service Quality
SL	Standardised Loading
SPSS	Statistical Package for Social Sciences
SPV	Special Purpose Vehicle
SQ	Service Quality
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TOWS	Threats, Opportunities, Weaknesses, and Strengths

US	User Satisfaction
UK	United Kingdom
V&V	Verification and Validation
VFM	Value for Money
VMS	Variable Message Signs

CHAPTER ONE
INTRODUCTION

1.1 Introduction

This chapter initially presents the Background (1.2) and the Statement of the Research Problem (1.3) from which stems the Research Questions (1.4). Next, the context in this thesis is briefly outlined. This is simply done by generating the Aim and Objectives (1.5) of this research with its Scope of the Study (1.6) and the Research Design and Methodology (1.7). This is concluded by the Summary of Findings and Recommendations (1.8) and an overview of the Organisation of the Thesis (1.9).

1.2 Background

Most infrastructure expenditures in developing countries have been funded directly from fiscal budgets. Nonetheless, several factors, such as macroeconomic instability and growing investment requirements, have shown that public financing is volatile and rarely meets crucial infrastructure expenditure requirements in a timely and adequate manner (Ferreira and Khatami, 1996). In accordance with the nineteenth annual survey conducted by Public Works Financing (2010), there have been over 1867 infrastructure concessions with estimated capital costs of over $US 712 billion proposed, awarded, or completed under a variety of forms of Public-Private Partnership (PPP) in over 100 countries around the world since 1985.

Furthermore, infrastructure development is one of the prerequisites for continued and sustainable growth of any country. Economic progress of a developing country in particular largely depends on the availability of adequate infrastructure facilities including transportation. In order to accelerate the rate of expansion and to fulfil the increasing various types of customer demand, the approach of Build-Operate-Transfer (BOT) has been introduced as a form of concession in some of the new projects in developing countries (Ofori, 2007) especially in Thailand (Tangkitsiri and Ogunlana, 2004). A Public-Private Partnership (PPP) infrastructure development can be defined as: "the permission private sectors acquire from the host government to provide infrastructure services under specific agreement and conditions of market mechanism"

Walker and Smith, 1995). Currently (2016), the most perceptible type of Public-Private Partnership (PPP) mechanism in transportation infrastructure development is the Build-Operate-Transfer (BOT) method (Walker and Smith, 1995; Dias and Ioannou, 1996; Malini and Raghavendra, 1996; Ogunlana, 1997; Mohamed-Asem *et al*., 2001; Zhang and Kumaraswamy, 2001; Zhang *et al*., 2002; Ghosh and Jintanapakanont, 2004; Zhang, 2005b; Abednego and Ogunlana, 2006; ADB, 2008; and World Bank, 2016). In other words, the BOT is one of PPP concepts whereby governments invite private sector companies involved in particular infrastructure projects in order to benefit from their expertise in the areas of design, construction, finance and the operation of the facility. Eventually, after a concession period, the project will be transferred to the host government (Levy, 1996; and World Bank, 2016).

In this research, one of the interesting PPP projects is the Second Stage Expressway operating under a concession granted by the Expressway Authority of Thailand (EXAT). The Background of EXAT is discussed in order to provide the rationale for focusing on User Satisfaction (US). The Mission of EXAT is to (i) provide expressway development according to standard and safety; (ii) provide innovative and valuable services; (iii) be efficient in property management in order to enhance expressway operation ability and to be beneficial to the communities; (iv) develop management and investment systems in order to add to the organisation's value. In addition, its Corporate Goals are (i) The expressways and properties will fulfil their full potential effectiveness; (ii) As public confidence, "Service Quality and Safety" should be a necessity; (iii) Turnover with steady growth and proper benefits.

1.3 Statement of the Research Problem

There are numerous Build-Operate-Transfer (BOT) projects already completed or are presently in progress in developing countries (Ofori, 2007) and a considerable number of them have been carried out in Thailand (Tangkitsiri and Ogunlana, 2004). In order to measure levels of road users' satisfaction, it is necessary to study the real benefits from projects such as Don Muang Tollway operated by Don Muang Tollway Public Company Limited (DMT) granted by the Department of Highways (DOH), Bangkok Mass Transit System (BTS) SkyTrain operated by Bangkok Mass Transit System Public Company Limited (BTSC) granted by the Bangkok Metropolitan Administration (BMA) and Mass Rapid Transit (MRT) underground operated by Bangkok Metro Public Company Limited

(BMCL) granted by the Mass Rapid Transit Authority of Thailand (MRTA). Some of these projects belong to the Expressway Authority of Thailand (EXAT). Due to these infrastructure projects being complex and large-scale the travelling public are significantly involved in these projects (Ogunlana, 1997; Ghosh and Jintanapakanont, 2004; ADB, 2006; Ofori, 2007; ADB, 2008; EXAT, 2015; and World Bank, 2016).

The crucial elements of project management in construction are project planning and monitoring. Project monitoring is comprised of a tracking process, comparing actual outcome to predicted outcome, analysing impact, and making adjustments as appropriate. This means that studies are carried out on the projects before the construction stage as part of the impact assessment study notably in terms of **risk management** (Li *et al*., 2005). The focus of this research, however, is on the project during the operational stage and its relationship to risk management. The outcomes of projects are strongly influenced by the communities and the risks involved in the system. Thus, project monitoring and tracking tasks are essential to keep the projects in their planned situations and ultimately to accomplish their goals (Chege and Rwelamila, 2000).

Moreover, there are research studies on risk management practices presenting that the focus of risk management is now shifting to a strategic approach. Risk involvement must also be universal and rigorous throughout the organisation (Ghosh and Jintanapakanont, 2004). Li *et al*. (2005) argued that risk management is undertaken from the problem of the state of having two parts or aspects in the sense that either the organisation can remove the risk or its effect. Furthermore, Forbes *et al*. (2008) argued that even though there are a significant variety of techniques on hand to deal with risk, there are various studies indicating that only a few of these techniques are employed in practice. Therefore, risk management is significant since balancing risk is becoming the only effective way to manage a corporation in a complex world (Akintoye *et al*., 1998).

Project risks include all factors or eventualities which cannot be definitively predicted and incorporated into the project costing. The larger and more complex the project is, the greater the risks will be. In large-scale infrastructure projects, typical risks include unforeseen engineering problems, cost and time overruns, currency exchange variations, project repatriation, unreliable market and demand projections, and environmental and social costs.

Hence, an integration of System Dynamics (SD) and Structural Equation Modelling (SEM) concepts with the approaches of project management implementation and the relationship between Service Quality (SQ) and Customer Satisfaction (CS) has been employed and developed to solve some of these research problems and to analyse the results as well as the scheme of Operations and Maintenance (O&M) management by employing clear strategic policies. This is essential in order to ensure smooth O&M from the basis of the designers' concept, mainly the experience along with the influence of individual characteristics of the decision-making process. Human minds, however, cannot assimilate all of these associated factors and so a model, which would enable road users to evaluate their satisfaction levels, would be of considerable benefit for BOT projects. On the other hand, the computer in System Dynamics (SD), a heuristic approach, can integrate all the explicit as well as implicit factors associated with a system in its simulation process (Sterman, 2000; Che *et al*., 2010; and Xu *et al*., 2012).

As already stated, a System Dynamics (SD) approach, which combines the historical data with the organisational learning and experiences, has been transformed into patterns. In system dynamics, these are called reference modes. Later on, when the model is able to reproduce the reference mode by simulation, it will be considered as a valid or base model. After being validated, the model will be further simulated for policy exploration (Sterman, 2000; Che *et al*., 2010; and Xu *et al*., 2012).

Furthermore, as discussed earlier, a SD model of the projects can be used as an effective tool for risk monitoring and control. The model can be used to identify early signs of risk appearance. The implementation of risks, and their consequences, can be monitored by analysing the project's behavioural aspects of concern. Effectiveness may also be evaluated through SD models (Ogunlana *et al*., 2003). In addition, the dynamic nature of the projects can be managed better than previous projects without modelling. It is extremely vital for the various levels of managers to make the right decision at the right time. Thus, some supplementary analyses have to be done to completely emphasise the risks which can occur in the projects. In order to do this, all of the pieces of information must be integrated by the auxiliary tool, e.g. a valid model. There is also a study on risk management in financial institutions which indicates that the role of chief risk officials has expanded dramatically, with more than half of them frequently involved in firm-level strategic decisions (Park *et al*., 2009). This emphasises the fact that boards of companies or organisations are now required to review their risk management framework.

This is an innovatively strategic approach in conducting research studies with providing a mechanism for modelling the relationship between "Service Quality" and "Satisfaction" transferring the academic knowledge from marketing, Customer Satisfaction (CS) to engineering, Road User Satisfaction (US). The variables of Perceived Value (PV), Service Quality (SQ) and Satisfaction (SA) have been argued and constructed. The model has initially been constructed as SQ, PV and SA, and then the concluding model consists of Behavioural Intentions. Behavioural Intentions (BI) have been discussed in depth in cases of marketing literature, yet few studies have been established in transport and construction engineering management (Parasuraman *et al.*, 1985; Parasuraman *et al.*, 1988; Oliver, 1993; 1999; Wen *et al.*, 2005; Joewono and Kubota, 2007; Oliver, 2010; and Sumaedi *et al.*, 2012)

In this thesis, a research model of CS based on the BTS SkyTrain project is firstly built; then, significant correlation coefficients of the research model can be structured by the model method. Put simply, with these coefficients, the main functions of system dynamics (SD) models are built. Through developing a dynamic model using data from BTS, this model can measure perceived satisfaction. Operations and process management principles together with practice lead to strategic impact (Tangkitsiri *et al.*, 2013a).

Then, a strategic scheme based on the theoretical knowledge transfer and modelling the relationship between "Service Quality" and "Satisfaction" would be worth considering (Oliver, 2010). Finally, this research has been bridging the gap in knowledge transfer between marketing and engineering as well as the modelling constructs in terms of SD and SEM.

1.4 The Research Questions

A key issue is to determine whether satisfaction levels of service users are being achieved. Since the objective of such a project is the well-being of the users of such facilities and other affected people, it is essential that those affected should be satisfied with the benefits generated by the project. In such a context, it will be particularly useful for the policy makers to study whether the objectives of the projects completed in the past have been achieved or not and how future projects may be improved.

The research analysed, reviewed and modelled the BTS SkyTrain users' satisfaction and this information can be applied to other projects such as the Expressway Authority of Thailand (EXAT) project studied through the BTS case study research.

The research questions are formulated as follows:

1. Are users satisfied with Public-Private Partnership (PPP) projects? If "yes", how satisfied are they? If "no", why not?
2. Can the level of satisfaction be improved and if so how?
3. What are the real benefits that the users will gain from the PPP projects?
4. Will the projects ensure "reliability of journeys" on the roads? (In other words, the more levels of satisfaction there are, the fewer levels of risk there will be.)

1.5 Aim and Objectives

The aim for this thesis is to improve the understanding of **U**ser **S**atisfaction **(US)** with PPP projects with a view to **improved C**ustomer **S**atisfaction **(CS)**. Additionally, a model for assessing the satisfaction of users has been developed. The following objectives have been set for the research:

- To identify and evaluate the benefits associated with PPP projects in Thailand
- To generate a conceptual model of User Satisfaction (US) with PPP from literature review and data from the BTS case study
- To develop a full model of User Satisfaction (US) on the PPP projects based on EXAT projects
- To verify and validate the model.

1.6 Scope of the Study

Initially, "scope" can be defined as the range of things that a subject, an organisation, or an activity deals with (The Oxford Advanced Learner's Dictionary, 2016). In this research study, therefore, scope can be defined as the range of modelling user satisfaction with transportation Public-Private Partnership (PPP) projects. The scope of the study is also restricted in order to allow the undertaken study completed within the time constraints and the research plan. In the context of the partnership, there are several interpretations in the form of PPP. Furthermore, Weihe (2008) indicated that there are four approaches of the partnership concept between public and private with the distinct

interpretations: (i) the urban regeneration approach; (ii) the policy approach; (iii) the infrastructure approach; and (iv) the development approach. The scope of the research study is confined to the infrastructure approach whilst the private investment is partnering with the public sectors as the PPP concept. The divergent elements, e.g. Construction Engineering Management (CEM) and Operations and Maintenance (O&M) are assimilated. In conjunction with the preceding statement, the study of PPP projects is resolved by transportation PPP infrastructure development projects. There are several categories of the infrastructure projects implemented in the BOT approaches. This study, however, depends on the transportation PPP projects which are bound by time constraints and the research plan.

Next, "Modelling User Satisfaction with Transportation Public-Private Partnership Projects" is selected as the subject of the research study to understand how to achieve satisfaction with PPP projects with a view to improve Customer Satisfaction (CS) on such projects. In addition, a model for assessing the user satisfaction has been developed. Hence, the context of **stakeholder** satisfaction in this thesis is mainly focused on the **users** and **officials** since they are the **major stakeholders** (Tangkitsiri and Ogunlana, 2004; and Tangkitsiri *et al.*, 2013b). In other words, the research studies the service quality and perceived satisfaction of the users and officials.

Even although there are categories of infrastructure projects implemented in the BOT approach, this research study relies on the BOT projects in Thailand. Suitable projects are selected which aim to benefit service users. According to the aim and objectives in this thesis, then, two transportation PPP infrastructure development projects in Thailand are selected as the case study researches in order to generate a model of user satisfaction. In other words, studying specific organisations such as BTSC and EXAT are able to assist in exploring the research aim and objectives and detailed strategies of modelling user satisfaction. The appropriate selection of the research strategies can be conducted by the research questions with the aim and objectives. As a Consequence, the case study research strategy aims to study the implementation of the transportation PPP infrastructure development projects in Thailand. The "Case Study Research" is selected as mentioned formerly in order to measure and model the levels of perceived satisfaction of EXAT users and officials as the major stakeholders (Tangkitsiri and Ogunlana, 2004; and Tangkitsiri *et al.*, 2013b).

In conclusion, the description of stakeholders in this research study is the people and organisations involved in the following particular projects, i.e. BTS and EXAT notably since they have invested their money in the projects. This definition is also limited to the involved people and/or organisations (e.g., government authorities, lenders, investors, shareholders, operators and users) using the models as an implement for project performance assessments, contract negotiations, appraisal reports, and tariff adjustments (Tangkitsiri *et al.*, 2013b; and the Oxford Advanced Learner's Dictionary, 2016). Even though there are a number of stakeholders as described, this thesis aims at the majority of **users, officials, and experts (including senior experts).**

Furthermore, in measuring and modelling levels of perceived satisfaction of EXAT users and officials, quantitative research methods have been used in order to be quantifiable. Due to the commercial nature of the transportation PPP infrastructure projects adopting the BOT method, user satisfaction is a crucial cause for concern. The results relate to expectation criteria which the users perceive the EXAT facilities as Service Quality (SQ), Perceived Value (PV), Satisfaction (SA), and Behaviour Intentions (BI). **These factors convey the real benefits to users.** Correspondingly, qualitative approaches have also been employed as part of research designs to qualify a verified and validated model as a valid model (base model). Then, the model can identify and evaluate the benefits associated with PPP projects in Thailand and/or other developing countries (Cronin *et al.*, 2000; Kotler, 2002; Tangkitsiri and Ogunlana, 2004; Kotler and Keller, 2006; Olorunniwo *et al.*, 2006; Chen, 2008; Hair *et al.*, 2010; Schumacker and Lomax, 2010; Lai and Chen, 2011; Lai and Chen, 2011; and Tangkitsiri *et al.*, 2013b).

1.7 Research Design and Methodology

As stated earlier, this thesis aims to achieve the enticement of the User Satisfaction (US) in understanding of PPP projects with a view to **improved Customer Satisfaction (CS).** Moreover, a model for assessing the satisfaction users has been developed. The following objectives have also been formulated and analysed for the research especially developing a valid model and creating a learning laboratory for experimenting with possible options for improving road user satisfaction in BOT projects using SD and SEM as modelling and simulation tools.

Research could be described as the intense study or work into a particular subject which involves studying the subject and trying to discover factual information notably in order to ascertain more detailed material about it (The Oxford Advanced Learner's Dictionary, 2016). It could also be quoted that research is the systematic collection and interpretation of information with a clear purpose, to find things out (Saunders *et al*., 2009). Furthermore, the keyword "research" could be described as a set of activities for the advancement of knowledge. In order to justify the truth to be believed as knowledge, a comprehensive research should be designed in such a way through constant reasoning.

The key term "research design" can be stated as "a grand plan of approach to the research topic". In other words, the research design is the plan for fulfilling research aim and objectives and answering the research questions in this thesis. It is essential to illustrate the research design and to prove it to be right or reasonable prior to organising a particular activity such as a research project (Saunders *et al*., 2009; Jonker and Pennink, 2010; Bryman, 2012; Wilson, 2012; Cooper and Schindler, 2014).

Moreover, in accordance with Creswell ***(2009)***, it is cited that research ***designs*** are plans and the procedures for research that span the ***decisions*** from broad assumptions to detailed methods of data collection and analysis. This plan involves several decisions. The overall decision involves which ***design*** should be used to study a topic. Informing this decision should be the ***worldview*** assumptions the researcher brings to the study; procedures of inquiry (called ***strategies***); and specific ***methods*** of data collection, analysis, and interpretation. The selection of a research ***design*** is also based on the nature of the *research problem* or issue being addressed, the researchers' personal experiences, and the respondents or audiences for the study.

Hence, Jonker and Pennink (2010) suggested that the first and principal step in setting up a piece of research is to define and discover the research model as a result of investigation, and how "validity" and "reliability" are achieved in terms of "content". In order to view both **validity** and **reliability**, this research employs the questionnaire as a research implement. That means a hypothesised classification of the categorical variables has been established and developed since both of the key literature reviews and significant resolution factors have been reached and determined after consideration (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al.*, 2010; Schumacker and Lomax, 2010; and Byrne, 2012).

In forms of mixed methods, the quantitative research methods have been adopted. After measuring and modelling the levels of the perceived satisfaction of EXAT users and officials, the results relate to expectation criteria notably focusing on the users who perceive the EXAT facilities as SQ, PV, SA, and BI. Correspondingly, the qualitative approaches have also been employed as part of research designs to qualify a verified and validated model as a valid model (base model). Then, the model can identify and evaluate the benefits associated with PPP projects in Thailand and/or other developing countries. Hence, this research study is the content and model validity of experts (Cronin *et al.*, 2000; Tangkitsiri and Ogunlana, 2004; Olorunniwo *et al.*, 2006; Chen, 2008; Lai and Chen, 2011; Sumaedi *et al.*, 2012; Kuo and Tang, 2013; Tangkitsiri *et al.*, 2013b).

In other words, a research strategy with its framework has also been adopted to meet the research objectives. Literature reviews have also been undertaken to identify previous research and the gaps which needed to be studied and filled. These include generating a model of the level of satisfaction.

In January 2014, the research study was organised to design a questionnaire of level of satisfaction with the EXAT services. Initially, these reviews were undertaken and revised by academic experts and cognitive interviews called "Index of Item-Objective Congruence or Item-Objective Congruence Index whose acronym is IOC (Rovinelli and Hambleton, 1977; and Turner, R.C., and Carlson, L. 2002). In order to meet the content validity, the questionnaire must be reviewed, stated and accepted logically by experts rating items of the content regarding how well they address the aim and/or objectives of the designed questionnaire. In other words, "content validity" is established as "logical validity", i.e. the degree to which the content of the objects reflects on the content domain of logical interest, and the result is legally and officially acceptable (Saunders *et al.*, 2009; Bryman, 2012; Cooper and Schindler, 2014; and Creswell, 2014).

Then, a pre-test study was conducted in Edinburgh, Scotland through a series of semi-structured interviews for shaping with verification and validation of both the preliminary and concluding findings in terms of designing a questionnaire. Then, a pilot test for this thesis research was conducted on the targeted users, i.e. EXAT road users to gain a pre-understanding of the phenomena under investigation. This is a Quality Control (QC) measure giving feedback which ensures that the questionnaire for the main survey is reliable. This pilot survey was carried out in April/May 2014. The outcome of the pilot study has been developed into the compact questionnaire which has now achieved the

terms of reliability and validity and will take the result to be part of academic papers in the future.

Even though the pilot study is one of the most critical aspects of a successful survey operation resulting in appropriate survey data, the pre-test is also essential in determining and examining the survey questionnaire before launching it to collect data. Pre-testing and piloting can be implemented to identify questions to ease the participants' comprehension of each question in the questionnaire clearly and without bias. Before launching the EXAT user satisfaction questionnaire as the pilot test, the pre-test has taken on the meaning of testing within a survey laboratory rather than in the survey field with the targeted population. This means that the pilot test was conducted after the preliminary questionnaire was reviewed.

After testing and analysing the pilot, it is sufficiently effective to collect and analyse data. From June to August 2014, over six hundred (600) copies of the EXAT satisfaction questionnaire were distributed to the relevant target groups and sites of the research study. In other words, the copies were placed on site, at convenient and comfortable locations, for the ease of the users and officials who are the major stakeholders. Questionnaire survey responses from 613 respondents, 561 EXAT users and 52 EXAT officials, were collected and analysed by statistical software packages, i.e. Microsoft Excel and Statistical Package for the Social Sciences (SPSS). LInear Structural RELationships (LISREL) is implemented to analyse the hypothesised user satisfaction model.

Finally, the model was constructed and developed by using the data from the BTS and EXAT projects. The model was also verified and validated by experts (including senior experts). This model was effectively accessible to be a valid model or a base model in order to identify and evaluate the benefits associated with PPP projects in Thailand and/or other developing countries.

In summing up, the research design and methodology fulfils the terms of "Modelling User Satisfaction with Transportation Public-Private Partnership Projects" as it is the title of this thesis as well as an attempt to attain the research questions, aim, and objectives. The summary of the Research Methodology Framework is illustrated in figure 1.1.

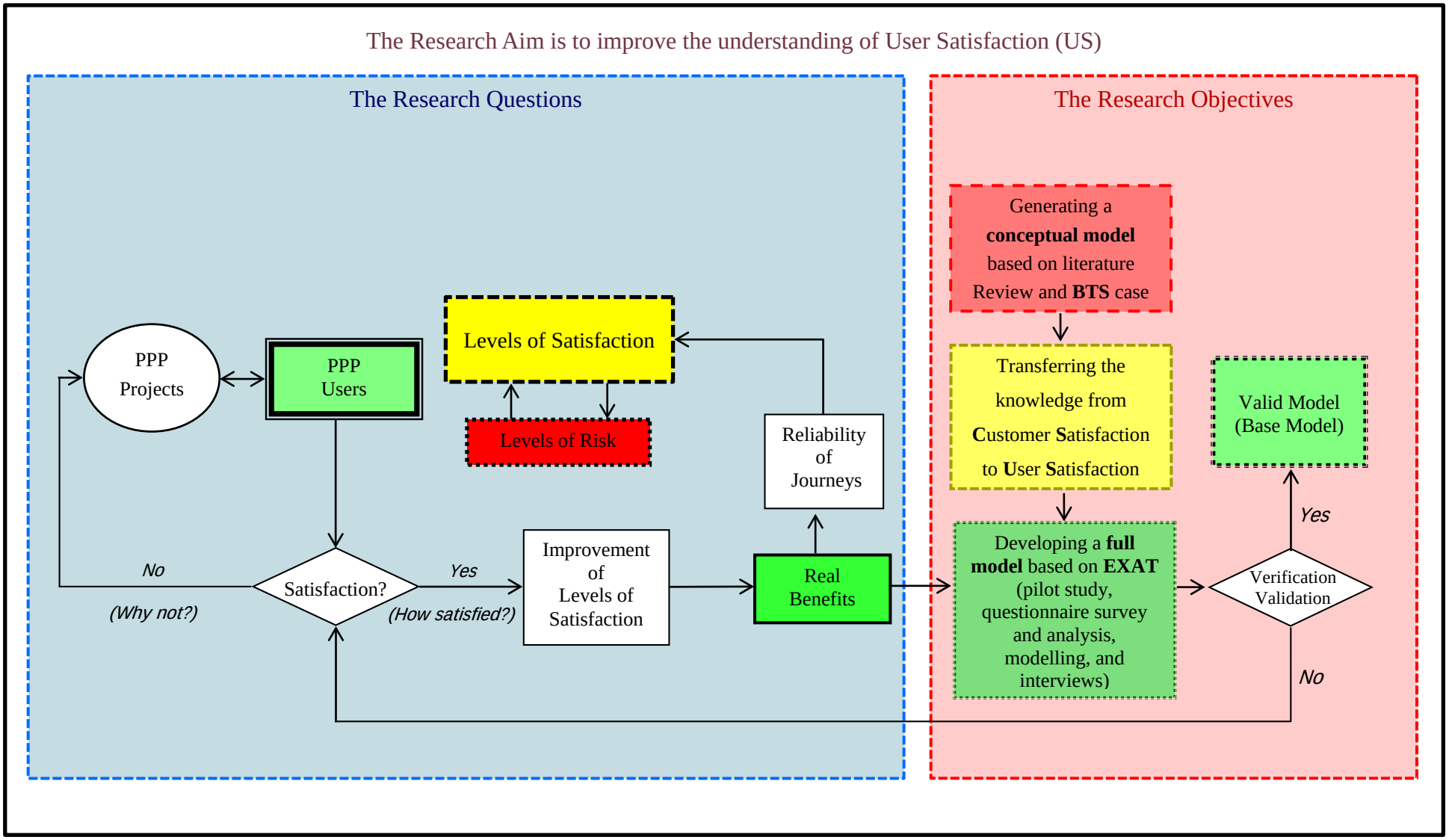


Figure 1.1: The Summary of Research Methodology Framework

1.8 Organisation of the Thesis

This thesis is structured and related to the philosophical research study worldviews. This study contains seven contextual specific chapters as performed in table 1.1 Thesis Outline. First of all, **Chapter One "Introduction"** discusses the introduction to the research. It provides explanations on the Background and the Statement of the Research Problem with the Research Questions, the Aim and Objectives, and Scope of the Study as well as the Research Design and Methodology concluding with the Summary of Organisation of the Thesis (1.8).

Then, "Chapter Two and Chapter Three" deliver thorough reviews of relevant literature. **Chapter Two "Public-Private Partnership and Satisfaction"** presents reviews of related articles. The study compliments the existing body of knowledge based on concepts and projects of the Public-Private Partnership (PPP) and a Satisfaction (SA) approach of "Knowledge Transfer" from (strategic) marketing, i.e. Customer Satisfaction (CS) to (transportation) engineering, i.e. User Satisfaction (US). This links between Service Quality (SQ) including Perceived Value (PV) and Satisfaction (SA) to Behavioural Intentions (BI) with reliability and validity of content and model as stated in the three chapters; Chapter Two, Chapter Four, and Chapter Six.

The link is also one of the academic research approaches to identify and understand the "Road User Satisfaction (US)" whilst **Chapter Three "Transportation Projects in Thailand"** links between the PPP concepts and projects with Stakeholder Satisfaction (CS) approaches. In addition, this chapter initially introduces Public-Private Partnership (PPP) transportation infrastructure development in Thailand, and then a generated idea and both System Dynamics (SD) and Structural Equation Modelling (SEM) theories were established. In this chapter, the relevant articles linking between Public-Private Partnership (PPP) projects in Thailand are mentioned. These include the two interesting projects of BTS and EXAT as the case study researches.

Chapter Four "Research Design and Methodology" and **Chapter Five "Study of the Construction of a Concept Model"** deliver from the research philosophy and design to reliability and validity of content. In addition, these chapters present the approach to derive a suitable research design and methodology and a conceptual model in answering the research questions and problems addressed in the literature review since the research

methodology is selected in accordance with the nature of the problem being addressed in this study. Moreover, this provides further emphasis and description of the data needed and the methodology selected for this research. It is also crucial to understand the reliability and validity of content and then model carefully as well as to generate a particular methodical approach in cases of Structural Equation Modelling (SEM) and the concepts as already mentioned in the first chapter as part of research design and methodology. This means that both Chapters Four and Five describe the reliability and validity of content and model consecutively as these are the most important key terms reviewed and located in SEM and its technique in Chapter Six.

The next chapter is **Chapter Six "Questionnaire Survey Analysis"**. This chapter reports all outcomes of the questionnaire of Expressway Authority of Thailand (EXAT) users and officials as part of the key stakeholders which is mentioned in the former chapters. It is also based on the cases of the involved people and projects from the surveyed questionnaires.

The statistically significant consequences persist in occurring in **Chapter Seven "Structural Equation Modelling"**. This chapter initiates the introduction of the technique of SEM which explains the SEM as the statistical approach adopted for data collection and analysis as well as other technical issues involved during the interview sections. A description of selected stakeholders is then followed before a discussion of the interview findings.

The final chapter, **Chapter Eight "Conclusions and Recommendations",** presents a summary of findings that directly engage the research questions. It discusses the policy implications of the research findings and recommendations. Furthermore, this chapter emphasises the contributions to the body of knowledge at the end of this chapter.

Table 1.1: Thesis Outline

Chapters		Research Outline
1	Introduction	The background of research study
2	Public-Private Partnership and Satisfaction	Literature review : an overview of major publications including relevant academic articles and textbooks in the research areas
3	Transportation Projects in Thailand	
4	Research Design and Methodology	Data collection
5	Constructing a Conceptual Model	Study of the a Conceptual Model Construction
6	Questionnaire Survey Analysis	Data analysis
7	Structural Equation Modelling	Model Verification and Validation (V&V)
8	Conclusions and Recommendations	A discussion and summary of findings and policy implication with contributions to the body of knowledge

CHAPTER TWO
PUBLIC-PRIVATE PARTNERSHIP AND SATISFACTION

2.1 Introduction

The preceding chapter established the reasons for this research and stated the aim and objectives. This included the research problem statement and research questions. In order to achieve academic and conceptual research frameworks, relevant literature was reviewed. The aim is to understand what efforts were made according to the concept of risks in PPP projects, what kind of methods were employed, the strength and/or limitations of these findings as well as identifying any gaps in the body of knowledge or published research to fill. In this chapter, the relevant literature linking between Public-Private Partnership (PPP) and Satisfaction (SA) schemes are reviewed. In other words, a generated idea was initially linked between the two significant concepts. The former concept is Public-Private Partnership (PPP) and its relevant schemes, e.g. Build-Operate-Transfer (BOT) and Transferring Risks. The latter forming approach is also Strategic Marketing Management with Service Quality (SQ), Satisfaction (SA) and Behavioural Intentions (BI) theories. The research studies contribute from marketing principles to the construction engineering management theory. This means that it transfers the knowledge from (strategic) marketing, i.e. Customer Satisfaction (CS) to (transportation) engineering, i.e. User Satisfaction (US). Furthermore, reliable academic journal materials and textbooks relevant to the research topic in the areas of construction engineering management with risk assessment and management and marketing management with Perceived Risk (PV), Perceived Value (PV) and Service Quality (SQ) being researched.

Similarly, this chapter presents the key publications that informed the understanding of the topic. Only the currently major journals in the area are presented due to word restrictions. Textbooks and professional publications in the research area were consulted in order to obtain critical understandings of keywords and key terms in cases of Public-Private Partnership (PPP) and Satisfaction (SA). Some relevant conference proceedings were also reviewed. This chapter concludes with a general summary of the literature reviewed and establishes the need for research study.

2.2 PPP Projects in General

A Public-Private Partnership (PPP) infrastructure development can be identified as the permission private sectors acquire from the host governments to provide infrastructure services under specific agreement and conditions of market mechanism and to finance the attainments of infrastructure property and the operation of their facilities (Walker and Smith, 1995; and Xu *et al*., 2012).

PPP is gaining popularity and acceptance as an innovative way to finance the construction of infrastructures in both developed and developing countries. For instance, it was estimated that the developing countries would spend US$ 200 billion annually on infrastructure, of which Asian countries account for 80%. The most noticeable and current type of PPP mechanism in transportation infrastructure development is the Build-Operate-Transfer (BOT) scheme (Walker and Smith, 1995; Dias and Ioannou, 1996; Malini and Raghavendra, 1996; Mohamed-Asem *et al*., 2001; Zhang and Kumaraswamy, 2001; and Zhang *et al.,* 2002).

Usually studies are made before constructing these projects as part of the feasibility or impact assessment study. However, studies can be done on the same projects whilst they are being built to evaluate and determine the effects of or benefits from the projects (Li *et al.*, 2005). In order to understand whether the **intended benefits** of the projects really exist, this research studies **the real benefits from the BOT projects in Thailand**. This will be extremely useful for the policy makers to know if the objectives of completed projects have been achieved and if they can be improved on when undertaking future projects.

2.3 Public-Private Partnership (PPP) Concepts

According to the World Bank Group (2016), Public-Private Partnership (PPP) is just one name for the involvement of the private sector in the delivery of public services. There are also several other names given to this concept such as Private Sector Participation (PSP) and outsourcing (Dias and Ioannou, 1996; and Liddle, 1997)

For infrastructures, PPPs generally refer to concession or Build-Operate-Transfer (BOT) contracts or any variant of them such as contracts where risks and responsibilities

transferred to the private sector are much wider than in traditional public works or service contracts. They usually entail a mix of construction, operation, commercial and financial issues, with a variable degree of risk sharing between public and private partners. A more restrictive definition of PPPs makes reference to the Private Finance Initiative (PFI). PFI has been launched in the UK since 1992 to employ private sector capital investments to fund public service projects. One of the main potential benefits of PPPs in infrastructure development is the optimisation of life cycle costs through innovation and adapted design (Li *et al.*, 2005).

2.4 Build-Operate-Transfer (BOT) Approaches

The acronym BOT is comprised of the following three aspects: Build, Operate and Transfer. The BOT scheme represents the commitment of a private enterprise to Build, Operate, and Transfer public infrastructure to a concession granting public agency after a certain period. The private sector invests in the development of public infrastructure and has the right to operate the infrastructure by imposing tolls or user charges to recover capital cost of construction and make a certain amount of profit under a specific concession period. At the end of the concession period, the infrastructure is to be returned to the host government (Levy, 1996).

As mentioned, BOT is a relatively new approach to infrastructure development. This enables direct private sector investment in large scale projects such as roads, bridges and power plants (UNIDO, 1996). The method of BOT is not complicated. The acronym of the keyword **"BOT"** stands for **B**uild, **O**perate and **T**ransfer, and the meaning of BOT is defined below:

Build - A private company (or consortium) agrees with a government to invest in a public infrastructure project (such as toll roads or power stations). The company then secures their own financing to construct the project.

Operate - the private developer then owns, maintains and manages the facility for an agreed concessionary period (e.g. 30 years) and recoups their investment through charges or tolls (e.g. road tolls or electricity sales).

Transfer - after the concessionary period the company transfers ownership and operation of the facility to the government or relevant state authority.

The Build-Operate-Transfer (BOT) or Build-Own-Operate (BOO) arrangement is similar to a concession for the provision of bulk services. BOT contracts are normally used for several types of projects, such as roadway projects (Euritt *et al*., 1994; and Yang and Meng, 2000) or railway projects (Ghosh and Jintanapakanont, 2004).

In a Build-Operate-Transfer or BOT (and its other variants namely Build-Transfer-Operate (BTO), Build-Rehabilitate-Operate-Transfer (BROT), Build-Lease-Transfer (BLT)) type of arrangement, the concessionaire undertakes investments and operates the facility for a fixed period of time after which the ownership reverts back to the public sector. In this type of arrangement, operating and investment risks can be substantially transferred to the concessionaire. However, in a BOT type of model the government has explicit and implicit contingent liabilities that may arise due to loan guarantees provided and default of a sub-sovereign government and public or private entity on non-guaranteed loans. By retaining ultimate ownership, the government controls policy and can allocate risks to those parties best suited to bear them or remove them (Ye and Tiong, 2003).

In a BOT concession, often the concessionaire may be required to establish a special purpose vehicle (SPV) for implementing and operating the project. The SPV may be formed as a joint venture company with equity participation from multiple private sector parties and the public sector. In addition to equity participation, the government may also provide capital grants or other financial incentives to a BOT project. BOT is a common form of PPP in all sectors in Asian countries. A large number of BOT port and road projects have been implemented in the region (Yang and Meng, 2000; Dey and Ogunlana, 2004; and Zhang, 2005a).

A key distinction between a franchise and BOT type of concession is that, in a franchise the authority is in the lead in specifying the level of service and is prepared to make payments for doing so, whilst in the BOT type the authority imposes a few basic requirements and may have no direct financial responsibility (Ashley *et al*., 1998).

The primary advantage of BOT contracts is that they mobilise private sector incentives and private sector finance, for what can be very costly new investment projects. Various BOT contracts, however, are not self-supporting and cannot be financed on a limited recourse basis. They often require the government to purchase the output in a take-or-pay contract which is necessary for the BOT developer to attract private capital. Unless

the government is able to make the purchase payments completely with user fees, the payments have to be subsidised by some other intergovernmental transfer. BOT contracts, nonetheless, can be a good way of rapidly rectifying major supply problems (Helm and Thompson, 1991).

It could also be stated that a public infrastructure project is said to be a "Build-Operate-Transfer" (BOT) project when the host government selects a private entity to finance and construct an infrastructure facility and gives the entity the right to operate the facility commercially for a certain period, at the end of which the facility is transferred to the government. Generally, the host government holds the title to the facility and the land on which it is built. Nevertheless, the parties may agree that the private entity will own the facility until it is transferred to the host government, in which case the project is referred to as a "Build-Own-Operate-Transfer" (BOOT) project (UNIDO, 1996).

"Build-Own-Operate" (BOO) are projects in which, as in BOOT projects, a private entity is engaged for the financing, construction, operations and maintenance of a given infrastructure facility in exchange for the right to collect fees and other charges from its users. Nonetheless, the private entity permanently owns the facility and its assets under this arrangement, and it is not under any obligation to transfer them back to the host government. In the BOO approach the assets remain indefinitely with the private sector partner and thus new private entry is permitted which may be complimentary to the existing public provider or in competition with it (Woodward, 1995).

2.5 Necessities of BOTs

There are a variety of potential advantages of the Build-Operate-Transfer (BOT) approach. These include the financing of infrastructure projects, and it is feasible as an alternative in most countries to the more conventional approach using self-governing borrowings or budgetary resources. Unlike in a fully privatised approach, the government retains strategic control over the project and will be transferred back to the public sector at the end of the concession period (Mohamed-Asem *et al*., 2001; Zhang and Kumaraswamy, 2001; and Zhang *et al*., 2002).

The sponsors' commitment of substantial equity and their need to protect and make a profit on their investment will give them a strong incentive to develop, design, construct

and operate the project as efficiently as possible. Likewise, the fact that commercial lenders will be committing substantial sums on a limited recourse basis provides additional assurance that the economic viability of the project will have been thoroughly analysed at the outset by knowledgeable financial experts. The mobilisation of private sector capital, initiative, knowledge and discipline in the development and implementation of infrastructure projects is therefore a very positive feature in the BOT approach.

There are other potential benefits to be derived from the BOT scheme to infrastructure financing (Yang and Meng, 2000). They include technology transfer, the training of local personnel and the development of national and regional capital markets and new financing instruments (Harris and McCaffer, 1995). Even though the returns that equity investors and lenders require are usually higher than the interest and fees a host government would have to pay on sovereign borrowings, there are numerous potential offsetting savings for the host government (Birgonul and Ozdogen, 1998).

Lenders and sponsors will bear a substantially greater risk in exchange for the higher return. More importantly, having the design, procurement, implementation and operation of the BOT project largely in the hands of the private sector should provide economies and efficiencies that will balance out or outweigh the higher financing costs (Love *et al*.,1998; Chege and Rwelamila, 2000; Zhang and Kumaraswamy, 2001; and Abednego and Ogunlana, 2006).

Where comparable projects remaining in the public sector, a competing private sector project may serve as a useful benchmark against which the host government can measure its public sector performance (Arndt, 1999). On the other hand, apart from the sponsors' side, the lenders' aspect may require a high level of equity in order to minimise the risk of debt repayment. The other significant point is the need of the sponsors' powerful assurance to ensure the financial viability of the BOT project since lenders may require the high level of equity (Zhang, 2005c).

The BOT approach, thus, is not a solution for the host government. BOT projects are complex from both financial and legal points of view. Private sectors require time to develop and negotiate, and they require host government involvement and support. They require a suitable political and economic climate, political stability, a defined and stable

legal and regulatory environment and a freely convertible currency as well as other elements that are appropriate for foreign investment generally (ADB, 2008).

2.6 Advantages of Privately Financed Project

Use of private sector financing provides new sources of capital. This reduces public borrowing and direct spending. In addition, it may improve the host government's credit rating. Ability to accelerate the development of projects would otherwise have to wait for, and compete for, scarce sovereign resources (Dias and Ioannou, 1996).

Additional advantages of Privately Financed Project are the use of private sector's capital, initiative and "know-how". This should reduce project construction costs, shorten schedules and improve operating efficiency. It will allocate, to the private sector project, risk and burden that would otherwise have to be borne by the public sector. The private sector is responsible for the operations, maintenance and output of the project for an extended period. Normally the government would only receive protection for the normal construction and equipment warranty period.

The involvement of private sponsors and experienced commercial lenders ensures an in-depth review and is an additional sign of project feasibility. Technology transfer, the training of local personnel and the development of national capital markets are also ensured (Ashley *et al*., 1998).

Government retention of strategic control over a project which will be transferred to the public at the end of the contract period is in contrast to full privatisation (World Bank, 1997). There is the opportunity here to establish a private benchmark against which the efficiency of similar public sector projects can be measured (Tiong, 1995). Moreover, there is the associated opportunity to enhance public management of infrastructure facilities. A critical challenge for developing countries is to identify the factors that make projects financially viable in the private sector. The following guidelines aim to assist governments to identify these factors as illustrated in the consecutive sections from 2.7 to 2.9.

2.7 Transferring Risks

According to Toor and Ogunlana (2010), it is stated clearly and firmly that different stakeholders from various socio-economic and cultural circumstances have their own motivation to achieve the project objectives. In terms of PPP projects, the uncertainties of long-term agreements and the complexity of project financing plans are able to generate additional risks to all PPP stakeholders (Zhang, 2005a).

The project risks include all factors or eventualities which cannot be definitively predicted and incorporated into the project costing (Chege and Rwelamila, 2000). The larger and more complex the project is, the greater the risks will be. In large-scale infrastructure projects, typical risks include unforeseen engineering problems, cost and time overruns, currency exchange variations, project repatriation, unreliable market and demand projections, and environmental and social costs (Dey, 2002). Private developers have traditionally stayed away from these types of projects precisely due to the high risks involved. In most large BOT projects the private sector has only been willing to participate if governments or IFIs assume a significant portion of the project risks (Mohamed-Asem *et al*., 2001; Thomas *et al*., 2003; Abednego and Ogunlana, 2006; and Forbes *et al*., 2008).

Whilst the application of the BOT model seems to depend heavily on mechanisms which guarantee the private sector against loss, there seems to be no corresponding mechanisms which guarantee that the projects lead to net gain and benefits of the projects for the governments and local people concerned (Park *et al*., 2009).

2.8 The Benefits of the Projects

At least three questions must be queried before clarifying the points of the project benefits as follows:

(i) Who really benefits from privatised infrastructure projects?

(ii) Who determines what infrastructure is needed?

(iii) Who should take on the costs and risks for infrastructure development?

In numerous cases, infrastructure projects respond primarily to the needs of industry, the private sector and general economic growth. These are justified on the theoretical

premise that everyone will eventually benefit from economic growth and industrialisation. As a result of the commercial nature of infrastructure projects adopting and applying the BOT approach, however, user perceived satisfaction is the major cause for concern (Dias and Ioannou, 1996; Mohamed-Asem *et al*., 2001; Zhang and Kumaraswamy, 200; Kotler, 2002; Zhang *et al*., 2002; Tangkitsiri and Ogunlana, 2004; Kotler and Keller, 2006; and Tangkitsiri *et al.*, 2013b).

This point of view demonstrates that the BOT concept will be a mechanism for accomplishing the private sector funds and improved efficiency in essential public investment projects. It is in this way that the private sector can access public funds for projects which are designed primarily to meet their own needs (Dias and Ioannou, 1996; Mohamed-Asem *et al*., 2001; Zhang and Kumaraswamy, 2001; Zhang *et al*., 2002; and Tangkitsiri and Ogunlana, 2004).

2.9 Advantages and Disadvantages of the Projects

Privatisation is expected to offer benefit to both public and private sectors by securing better projects and better value for money (VFM). It can also be achieved through improved allocation of risk, better incentives to perform, close integration of service need with design and construction, a clearer focus on the respective responsibilities, a continuing commercial incentive and more potential for effectiveness (Akintoye and Taylor 1995).

Walker and Smith (1995) summarised the advantages and disadvantages of BOT scheme as follows:

Privatisation is a policy decision having wide repercussion on the political and social arena. From a government viewpoint, the following are generally perceived benefits of privatisation.

1. Relieving the financial and administrative burden of the government in undertaking and maintaining much needed infrastructure.
2. Introducing commercial discipline, competition, the economic efficiency and productivity of the projects.
3. Ensuring profitability by a vigorous cost benefit analysis and viability study carried out by the private sector.

4. Justifying positive results of the need for the facilities. Poor response from the private sector reflects uncertain demand for the facilities.
5. Shortening the time for the realisation of the completed facilities will be anticipated by the private sector as an early income will be more probable.
6. Utilising the expertise of the private sector can reduce the size of the public sector establishment.
7. Stimulating private entrepreneurship and investment should accelerate the rate of growth of the economy.
8. Transferring the risks of finance, construction and operation to the private sector.

On the other hand, profits, reputation, and experiences are the advantages for private project participants. The rise of the BOT concept in privatisation of infrastructure projects has been of benefit to contractors in the sense that they are now able to be involved in the construction and operation of traditionally public-sector projects such as toll roads and power plants (Tiong, 1995)

One of the most concerning points is recognised as "efficiency gain" by privatisation. In this regard, Moavenzadeh and Liddle (1995) comment: in a case of the UK, the most important criterion for Private Finance Initiative (PFI) is known as "Value for Money" (VFM). Their objective is directed to the achievement of VFM (Akintoye *et al*., 1998). Considering all the advantages and disadvantages of all of possible public service arrangement alternatives, the one which can generate the largest VFM is then selected (Li *et al*., 2005).

2.10 From Customer Satisfaction (CS) to User Satisfaction (US)

Initially, this section provides the meanings of fundamental marketing keywords in several academic research studies, i.e. Customer, Satisfaction (SA), Customer Satisfaction (CS), and Requirement. These words are relevant to marketing researchers in both academic and industrial fields. Then, further explanations of the meanings and concepts of marketing keywords or phrases continue to define Customer Loyalty with its assessment, Perceived Risk (PR), Perceived Value (PV), Service Quality (SQ), and Behaviour Intentions (BI).

Furthermore, this part delivers concise and precise history of CS research studies. Contemporary efforts to link the relationship between SQ, PR, PV, CS/SA, and BI are also reviewed. The first professional research studies into the measurement of customer satisfaction took place in the early 1980s. These strategic marketing management researches characteristically elaborated the dynamic movement of Satisfaction (SA). Initially, academic research studies included "Measurement and Evaluation of Satisfaction Process in Retail Settings" by Oliver (1981) and "An Investigation into the Determinants of Customer Satisfaction" by Churchill and Suprenant (1982). Their research articles emphasised the **operationalisation** of Customer Satisfaction (CS) and its antecedents (Day and Crask, 2000). Then, by the middle of the 1980s, the emphasis of the marketing researches in both academic and industrial fields had shifted to the clarification and fulfilment of marketing strategies.

In addition, the researches focused on designing optimised implantation to measure CS and its marketing relevance, e.g. SERVQUAL as a multiple-item scale for measuring consumer perceptions of Service Quality (SQ) (Parasuraman *et al.* 1985; 1988; Zeithaml *et al.,* 1990). Their conceptual model of Service Quality (SQ) and its implication have performed the major role in achieving and sustaining the theories of CS/SA since 1985 (Parasuraman *et al.* 1985; 1988; Zeithaml *et al.,* 1990; Lambin, 1997, Grewal *et al.* 1998; Day and Crask, 2000; Parasuraman and Grewal, 2000; Sweeney and Soutar, 2001; and Chen and Dubinsky, 2003).

Not only are these keywords, key terms and concepts essential to researchers in academia and industry, but they are also identified as key factors in strategic management (Zeithaml *et al.*, 1985). Lastly, an equation with definition of User Satisfaction (US) will be expressed (Tangkitsiri *et al.*, 2013b).

First of all, the Oxford Advanced Learner's Dictionary (2016) defines "Customer" as "a person or an organisation that buys goods/products or uses services from a shop/store or business". In this thesis, "Customer" can often be substituted with the term "Consumer" or "User". Correspondingly, "Satisfaction" is "the good feeling that you have when you have achieved something or when something that you wanted to happen does happen; something that gives you this feeling".

Moreover, the definition of Customer/Consumer Satisfaction has been widely debated. Customer Satisfaction can be experienced in a variety of situations connected to both goods/products and services (Oliver and DeSarbo, 1988; Day and Crask, 2000; McDougall and Levesque, 2000; and Gallarza and Gil, 2006). Highly personal assessment is greatly affected by customer expectations. Satisfaction is based on the customers' experience in contact with the organisation and personal outcomes. In terms of business literature, this is also called the "moment of truth". Some researchers define a satisfied customer within the private sector as "one who receives significant added value" to personal outcomes. This is a definition which may apply just as well to public services. Customer Satisfaction differs depending on the situation and the products/goods or services (Oliver, 1981; Day and Crask, 2000; McDougall and Levesque, 2000; Oliver, 2010).

Similarly, "Requirement" is defined in ISO 9000:2005 as "need or expectation that is stated, generally implied or obligatory". In other words, customer needs and expectations **must** be met. The requirements emphasise that organisations should monitor information relating to customer perceptions as to whether the organisation has fulfilled customer requirements or not (Oliver, 1999).

Indeed, "Customer Satisfaction" is a major concept within ISO 9001:2005. The standard goes much further than the concept of Customer Satisfaction. It is not acceptable for organisations to merely ask customers if they are satisfied. The standard requires that customer perceptions can be measured to see the degree of perceived satisfaction, which provides data for the organisation to improve its performance. Companies may discover that some customers continue to purchase their products or services, yet they may not be fully satisfied with them (Oliver, 1981; Oliver and DeSarbo, 1988; Oliver, 1999). This requirement gives the customer an opportunity to communicate their "discomfort" and, again, provide an opportunity for improvement (Lambin, 1997).

Furthermore, Oliver (2010) stated that a previous study defined a variety of forms of Customer Satisfaction. Multiple interpretations of satisfaction emanate from differences such as: the type of response (cognitive or affective); the time of evaluation (immediate to an encounter or retrospective of past consumption); the object of evaluation (a transaction, a firm, or an attribute); and the psychological process used to construe the response (expectations, attribution, or equity perceptions). As a result, satisfaction must

be measured and monitored continuously in order to assess the current performance of the product, the service, or the organisation in the eyes of customers (Oliver, 1981; Chung and Wirtz, 1998; Oliver, 2000; Peyton *et al.,* 2003; Kotler, 2002; and Kotler and Keller, 2006).

As a Consequence, Customer Satisfaction can have a significant influence on operation performance of enterprises. With proper assessment tools, Customer Satisfaction of the provided products or services can be assessed and further provide more products and services that can meet customers' needs (McDougall and Levesque, 2000; Guo and Jiraporn, 2005).

In conclusion, satisfaction was commonly defined in terms of need fulfilment, pleasure, cognitive stage, attribution, or benefit by early researchers. According to Oliver (2010), it is difficult to distil the definition of "Customer Satisfaction (CS)" due to the diversity in definitions. Even though previous researchers defined consumer/customer satisfaction in cases of variables or factors which were different yet interrelated, a concise definition would be "CONSUMER'S FULFILMENT RESPONSE". Likewise, this includes emotional features of consumer/customer response towards the experiences of either products or services in cases of CS (Chung and Wirtz, 1998; Parasuraman *et al.,* 1988; Oliver, 2000; Peyton *et al.*, 2003; Kotler, 2002; and Kotler and Keller, 2006). In simpler words, according to Oliver (1981), Customer Satisfaction is "a summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer's prior feelings about the consumption experience".

Assessment of Customer Loyalty

As defined already, according to the Oxford Advanced Learner's Dictionary (2016), "Customer" is a person or an organisation that buys something from a shop/store or business. In addition, the definition of "Loyalty" is the quality of being faithful to somebody/something and supporting them or it.

In consumer and customer marketing research studies, customer loyalty has long been thought of as a significant goal (Reichheld, 1996; Reichheld and Schefter, 2000; and Reichheld *et al.,* 2000). Both marketing academics and professional experts have undertaken to discover the most important backgrounds and experiences of the research

studies in terms of customer loyalty (Reichheld, 1996; Oliver, 1999; and Reichheld *et al.*, 2000).

According to Oliver (1999) and Parasuraman and Grewal (2000), there have been various research studies conducted which indicated that there have been two further successful achievements which generated and developed customer loyalty. Hence, two of the additional valid and efficient components to create customer loyalty are (i) to satisfy customers and (ii) to deliver exceptional value gleaned from either services or products in cases of excellence and quality (Oliver, 1999; and Parasuraman and Grewal, 2000)

There are, furthermore, marketing research studies on customer loyalty assessment being based on the definition of customer loyalty. According to Hicks *et al*. (2005), it is claimed that assessment of customer loyalty is generated;

(i) by the will and conduct of repurchase;
(ii) by the will to introduce or recommend companies to others; and
(iii) by the establishment of public esteem.

Commenting on Drucker (1954), Hargreaves (2006) remarks that the only valid definition of business purpose is to create customers. Additionally, they mention that the two basic functions of entrepreneurial business are marketing and innovation. Successful organisations of the future will be those that can provide goods and services to the customers who want them, where they want them, how much and at what price they are prepared to pay for them, thereby delighting rather than merely satisfying customers.

Customer Satisfaction will lead to loyalty, which is one of the critical indicators used to measure the success of a marketing strategy. Services cannot, however, be performed without some form of relationship between the producer and the consumer and cannot be stored and retained for later use in the way typical of many tangible goods or products (Drucker, 1993; and Hargreaves, 2006).

In conclusion, satisfaction has been defined and measured in different ways over the years (Caruana *et al*., 2000; Cronin *et al*., 2000; and Oliver, 2000). One of the latest formal definitions of **"satisfaction"** is a composite construction of an overall evaluation. This has been developed by Oliver (2000), who proposed it to be "the consumer's satisfied response, the degree to which the level of fulfilment is pleasant or unpleasant". This study

defines satisfaction as a consumer's accumulative overall evaluation of positive effective response to a given product category. The most widely agreed-upon definition of loyalty is a behavioural response expressed over time (Dick and Basu, 1994). Oliver (2000) has defined **"loyalty"** as "a deeply held commitment to repurchase a preferred product or service in the future". Furthermore, combinations of past frequent behaviour and intention to repurchase are used to assess a global and cumulative loyalty measure. As a result, loyalty is in this study defined as a cumulative construction including both the act of consuming (action loyalty) and expected consumption (future repurchasing).

Similarly, **"customer loyalty"** is most commonly defined as patronage behaviour expressed over time and by patterns of repurchase (Andreassen and Lindestad, 1998; and Guo and Jiraporn, 2005). Several researchers emphasise that authentic customer loyalty should encompass a positive attitude and a sense of commitment to the organisation. Numerous studies have demonstrated a positive relationship between satisfaction and various aspects of loyalty such as customer patronage and retention (Oliver, 1981; Dick and Basu, 1994 Caruana *et al*., 2000; Cronin *et al*., 2000; and Oliver, 2000).

Perceived Risk

"Risk" has already been stated in "Transferring Risks (2.7)" section in cases of PPP projects. This part, however, considers "Risk" as "Perceived Risk" in terms of Strategic Marketing Management. In this thesis, the acronym of "Perceived Risk" is "PR". Service organisations are generally characterised by high variability in quality, and customers may also have a high level of uncertainty in cases of the quality of future performance.

In marketing research studies, the anticipation of adverse consequences and the perceptions of uncertain outcomes are generally termed "Perceived Risk" (Sweeney *et al.*, 1999; and Hargreaves, 2006). PR can additionally be defined as a subjective expectation of a loss as well as business corporations making efforts to create and provide their customers with a higher value added, which consists of elements such as lower prices, additional benefits and uniqueness in services (Andreassen and Lindestad, 1998; Agarwal and Teas, 2002). This means that top management should be aware of how to accommodate customers' needs/expectations by providing a better quality of services to the customers (Oliver, 2000; and Solomon *et al*., 2006).

According to Zeithaml (1988) who quoted the keyword, *brands, i.e. products or services,* several research studies have indicated that price is able to be used as a quality clue. This means that the quality clue is obtained to a greater degree *when brands are unfamiliar* than *when brands are familiar*. Furthermore, the studies have expressed that when perceived risk of making an unsatisfactory alternative is high, consumers or customers select higher priced products (Dodds and Monroe, 1985; Dodds *et al.,* 1991; Agarwal and Teas, 2002; Berry, 2000; Brodie *et al.*, 2009; Abratt and Kleyn, 2012; and Bravo *et al.,* 2012).

A service brand, nonetheless, differs from a product brand. Therefore, consumers or customers perceive a brand relating to whether it is a brand of the product or service. When it is a service brand, the consumers or customers tend to gather information to generate brand perceptions from the overall organisation rather than an individual product (de Chernatony and Dall'Olmo Riley, 1999; and Devlin and McKechnie, 2008). Additionally, the nature of service requires the customers to participate in the service production process (O'Cass and Grace, 2004; Hinson *et al.,* 2011).

Moreover, service intangibility means that consumers or customers are not able to evaluate service quality (SQ) before purchasing and experiencing it. Therefore, brands tend to play an essential role in purchase decision making whereas consumers depend on a brand in recognising service quality (Hinson, *et al.*, 2011; and Bravo *et al.*, 2012). When the brand is strong, risk or uncertainty connects with the service and tends to reduce and increase the probability of purchasing services provided by the brand and company (de Chernatony & Dall'Olmo Riley, 1999; Berry, 2000).

Perceived Value

According to Zeithaml (1988), it is described that patterns of responses from the exploratory study can be grouped into four distinct definitions of value. These mean that

(i) value is low price;
(ii) value is whatever they want in a product;
(iii) value is the quality they acquire for the price they pay;
(iv) value is what they get for what they give.

These four consumer expressions of value can also be captured in one overall definition. Perceived Value, *its acronym is PV in this research,* is "the consumer's overall assessment of the utility of a product based on perceptions of what is received and what is given". In

other words, the consumers sacrifice both money and other resources such as time, energy, and effort to attain products and services.

The four distinct categories of value have been validated since 1988 in order to determine the variety in terms of meanings of value and to form the concept of value (Zeithaml, 1988). This research study obtains the concept and understandings of Zeithaml (1988) from shopping literature to classify the purchase-related costs and benefits.

Correspondingly, the construct of Perceived Value (PV), i.e. Value for Money (VFM) has been discovered to commonly act as a mediator between the factors and purchase/behaviour intentions (Sweeney *et al.*, 1999). Likewise, Zeithaml (1988) modified the model which was originally suggested by Dodds and Monroe (1985).

It is proposed that the construct ought to be comprehended as a trade-off between benefits and sacrifices in which consumers/customers deduce benefits by assessing all of the quality or feature of products and services (including price). Even though this has been the same key term as "Perceived Value", it is meant as the same concept. Different researchers have applied divergent terms to define the construct of perceived value (Woodruff and Gardial, 1996; and Woodruff 1997).

Including Perceived Value, the most generally applied marketing terms are Customer Value, Value, and Value for Money (VFM). Then, Value for the Customer, Value for Customers, Customer Perceived Value, Perceived Customer Value, Consumer Value, Consumption Value, Buyer Value, Service Value, and Acquisition and Transaction Value are the least commonly used (Dodds and Monroe, 1985; Monroe and Chapman, 1987; Zeithaml, 1988; Dodds *et al.* 1991; Chang and Wildt, 1994; Reichheld, 1996; Grewal *et al.* 1998; Parasuraman and Grewal, 2000; Sweeney and Soutar, 2001; Chen and Dubinsky, 2003; Gallarza and Gil, 2006)

Service Quality

Before detailing the explanation of the meaning and concept of Service Quality, the key term should initially be defined by the Oxford Advanced Learner's Dictionary (2016).

Initially, the definition of "Service" is "a business whose work involves doing something for customers but not producing goods; the work that such a business does, e.g. the

development of new goods and services or EXAT services". The latter keyword "Quality" is also defined as "the standard of something when compared to other things like it; how good or bad something is".

Similarly, Parasuraman *et al.* (1985) noted that "efforts in defining and measuring quality have come largely from the goods sector in terms of "Service Quality Existing Knowledge". As stated by the prevailing Japanese philosophy, quality is "zero defects--doing it right the first time". Additionally, it can be defined as "conformance to requirements" (Crosby, 1979).

Likewise, Lewis and Booms (1983) defined that Service Quality (SQ) is "a measure of how well the service level delivered matches customer expectations. Delivering quality service means conforming to customer expectations on a consistent basis". Marketing researchers as well as managers of service companies/organisations concur that Service Quality (SQ) involves a comparison of expectations with performance (Parasuraman *et al.,* 1985).

In order to understand "service quality" comprehensively, there are three acknowledged and documented attributes of services:

(i) intangibility;
(ii) heterogeneity;
(iii) inseparability.

These are significant to comprehend the elementary aspects of service quality to measure the quality of service. Initially, the first three well documented characteristics of services developed during the service quality revolution and advocated by Regan (1963) and Parasuraman *et al.* (1985), i.e. intangibility, heterogeneity, and inseparability.

This is, then, followed by other key research studies including "SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality" and "Delivering Quality Service: Balancing Customer Perceptions and Expectations" (Parasuraman *et al.,* 1988; and Zeithaml *et al.,* 1990). Both of the research findings are based on five principal dimensions of tangibility, reliability, responsiveness, assurance, and empathy. This expresses the development of a multiple-item scale for measuring service quality; that is why this instrument is the so-called "SERVQUAL".

Table 2.1 describes the development of a 22-item implement for assessing customer perceptions of service quality in service and retailing organisations.

Table 2.1: Service Quality (SQ) Scale Dimensions for Customers/Users

The 5 Principal Dimensions	Definition
1. Tangibles: Appearance of physical facilities	▪ Modern communication materials/equipment ▪ Visually appealing physical facilities ▪ having a smart and professional appearance ▪ Visually appealing materials associated with service
2. Reliability: Ability to provide service dependably and accurately	▪ Presenting service as guaranteed ▪ Expressing dedication in solving their problems ▪ Performing the service correctly the first time ▪ Providing the service at the promised time ▪ Upholding error-free records
3. Responsiveness: Willingness to assist and deliver prompt service	▪ Informing precise information of when service will be undertaken ▪ Providing prompt service ▪ Readiness to assist ▪ Willingness to respond to requests expeditiously
4. Assurance: Knowledge base and courtesy of members of staff	▪ Confidence building qualities ▪ Feeling safe in transactions ▪ Being consistently courteous ▪ Having ability to answer all questions
5. Empathy: Caring attention to the customers/users provided by the service organisation	▪ Giving them individualised attention ▪ dealing with them with a caring thoughtful attitude ▪ Having them best interest at heart ▪ Understanding their needs ▪ Having convenient operating hours

Adopted from Parasuraman et al. (1988) and Zeithaml et al. (1990)

Next, this research study is **construction orientated** on the basis of practical aspects of industrial management and the modern marketing management concept (Drucker, 1954). As already mentioned, Service Quality (SQ) is part of Customer Satisfaction (CS) as its antecedents including Perceived Value (PV). Moreover, this study argues that quality is always in the eye of the customers as its eyewitnesses, and it is able to be based on both predetermined specifications and user perceptions (Regan, 1963; Parasuraman *et al.*, 1985; 1988; Zeithaml *et al.*, 1990; Grewal *et al.*, 1998; Parasuraman and Grewal, 2000; Sweeney and Soutar, 2001; and Chen and Dubinsky, 2003).

In accordance with one of the legendary quotations by Philip Crosby (1926-2001), it is quoted that "People want some wise and perceptive statement like, 'Quality is ballet, not hockey'." (Crosby, 1979; and Parasuraman *et al.,* 1985). This means that dance is based on quality rather than quantity. One can measure the quality of outsourced services employing perceptive judgements of the service users. For hockey game, however, one can measure the final score at the end of a hockey match!

Furthermore, "SERVQUAL" is a quality management framework. It was developed by Parasuraman *et al.* (1988) and Zeithaml *et al.* (1990) to measure quality in the service sector. Not only is this multiple-item scale for measuring service quality named "SERVQUAL" in terms of marketing research studies, but Service Quality is recognised as "SQ" in this thesis.

The last and most significant marketing point of view is in consonance with Lewis and Booms (1983) and Parasuraman *et al.* (1985), it can logically be suggested that Service Quality (SQ) is a function of the differences between Expectations and Performances along the dimensional aspects of quality. They have established and refined a service quality model analysis since 1983. In other words, **Service Quality (SQ)** is the comparison of "**Expectations**" with "**Performances**". In addition, this marketing research tool implied that in the form of customers, SQ has the gap between "Expected Services, i.e. Expectations (E)" and "Perceptions of the Performances of service providers (P)" in terms of customers and deliveries of SQ on the side of marketers. Hence, Service Quality (SQ) can be determined and examined by deducting Expectations (E) from Performances' Perceptions (P). This is formulated by the SQ equation as follows:

$$SQ = P - E$$

Behavioural Intentions

This is the last key term identified as a key factor in the series and theories of strategic and marketing management. In order to comprehend the details of the meaning and concept of Behavioural Intentions, the defined keywords are contributed by the Oxford Advanced Learner's Dictionary (2016). **"Behavioural"** *(notably American English* **"Behavioral"***)* is "connected with behaviour" or "connected with the scientific study of human and animal behaviour". "Intention" (*plural* **"Intentions"**) is "what you intend or plan to do, i.e. your aim".

According to Dictionary of Sport and Exercise Science and Medicine by Churchill Livingstone (2008), the definition of this key term, "Behavioural Intentions" is a person's conscious or deliberate intention to engage in behaviour. This can also be defined as a person's perceived likelihood or "subjective probability that he or she will engage in a given behaviour" (Committee on Communication for Behavior Change in the 21st Century, 2002).

In addition, according to Likert (1932) and Armitage and Conner (2001), BI is "**Behaviour**-Specific and operationalised by direct questions, e.g. 'I intend to [behaviour]' with **Likert Scale** response choices to measure relative strength of intention". **Intentions** have been represented in measurement by other synonyms such as 'I plan to [behaviour]' and have been distinct from similar concepts including desire and self-prediction (Armitage and Conner, 2001). Ajzen (1991) argued that BI reflects how hard a person is willing to try, and how motivated he or she is, to perform the behaviour.

Previous research studies have already found that Behavioural Intentions (BI) have been affected by several antecedent variables including SQ, PV, and SA (Cronin *et al.,* 2000; Olorunniwo *et al.,* 2006; Chen, 2008; Lai and Chen, 2011; Sumaedi *et al.,* 2012; and Kuo and Tang, 2013).

In terms of marketing articles, Behavioural Intentions (BI) have been reviewed. Nevertheless, there are few experimental research studies being established in transportation industries (Wen *et al.,* 2005; Joewono and Kubota, 2007; Lai and Chen, 2011; and Sumaedi *et al.,* 2012). In order to comprehend the BI of public transport, passengers are significant and favourable to BI. Then, BI will lead to Customer Loyalty. The last and the most important phase is "Customer Loyalty". This is the essential role for success and survival of the service organisations and/or companies (Wen *et al.,* 2005; and Lai and Chen, 2010).

Finally, instead of asking whether customers are satisfied, organisations and/or companies may be encouraged to determine the extent to how much loyal customers hold them accountable. In the public sector, the definition of Customer Satisfaction (CS) is often linked to both the personal interaction with the service provider and the outcomes experienced by service users (Grenci and Watts, 2007).

Service Quality (SQ), Customer Satisfaction (CS), and Behavioural Intentions (BI) have been the key subject of interest for the researchers as previously mentioned (Olorunniwo *et al.,* 2006). Additionally, several academic research studies claim that switching costs, as a significant regulating variable, meaningfully impacting on customer loyalty through such Service Quality (SQ) factors as Perceived Value (PV) and Customer Satisfaction (CS) (Oliver and DeSarbo, 1988; Oliver, 1999; Parasuraman and Grewal, 2000; Gallarza and Gil, 2006). According to ISO 9000:2005 and Tangkitsiri *et al.,* (2013b), "Customer Satisfaction" is defined as "the customer's perceptions of the degree to which the customer's requirement has been fulfilled".

Furthermore, Customer Satisfaction will occur when customer expectations can be met. For example, if an organisation or a service provider supplied its customers or users with a good level of service higher than they expected, the organisation or the service provider would meet the customers' or users' expectations. According to ISO 9000:2005, Grenci and Watts (2007), and Tangkitsiri *et al.* (2013b), then, this means that "User Satisfaction" (US) can also be referred to or defined as "Customer Satisfaction" (CS) in the context of this thesis. **Satisfaction** is the short form of "User Satisfaction" (US) and "Customer Satisfaction" (CS), and its acronym is "SA" in this research. Similarly, in this thesis, the User Satisfaction (US) and/or Satisfaction (SA) is represented by the following equation:

SATISFACTION = SERVICES – EXPECTATIONS

In order to fulfil the research questions, aim, and objective, one must acquire knowledge of instances of marketing (CS) and engineering (US) concepts which link and model both SD and SEM stimulation techniques in PPP transport projects. In other words, there are still knowledge gaps between PPP, SD, SEM, and CS/US concepts which need to be achieved. Furthermore, these are part of the research study to fulfil the terms of "Modelling **User Satisfaction** with Transportation Public-Private Partnership Projects" as it is the title of this thesis as well as to attempt to attain the research questions, aim, and objectives.

In addition, this chapter presented relevant literature which informed the critical understanding of the topic. Furthermore, literature review needed to be strengthened in the areas of Customer/User Satisfaction (CS/US) studies on PPP and/or transportation projects. Empirically, preceding research studies have confirmed a direct positive

relationship between Customer/User Satisfaction (CS/US) and Behavioural Intention (BI) in numerous industries including public land transport services (Parasuraman *et al.,* 1985; Parasuraman *et al.,* 1988; Oliver, 1981; 1993; 1999; Wen *et al.,* 2005; Joewono and Kubota, 2007; Chou and Kim, 2009; Oliver, 2010; Lai and Chen, 2011; Wu *et al.,* 2011; Sumaedi *et al.,* 2012; and Kuo and Tang, 2013).

Review of transportation literature shows that various studies have been undertaken concerning Service Quality (SQ) and Satisfaction (SA). Chou and Kim (2009), Lai and Chen (2011), Wu *et al.*(2011), and Kuo and Tang (2013) focused on land transport. These research studies include road, rail, and urban especially the railway transportation sector to develop a model defining the relationship between Customer/User Satisfaction (CS/US) and transportation projects in cases of BOT/PPP.

Kuo and Tang (2013) studied the relationships among service quality, corporate image, customer satisfaction, and behavioural intention for the elderly in high speed rail services. Chen (2008) investigated structural relationships between service quality, perceived value, satisfaction, and behavioural intentions for air passengers. Additionally, Lai and Chen (2011) studied the behavioural intentions of public transit passengers in cases of the roles of service quality, perceived value, satisfaction and involvement. They highlighted behavioural intentions and explored the relationships between passenger behavioural intentions and the numerous factors that affect them in a new public transit system.

Sumaedi *et al.* (2012) argued that Behavioural Intentions (BI) have been discussed in depth in cases of marketing literature articles. Nonetheless, few experimental research studies have been established in transportation sectors. Chou and Kim (2009) measured the impact of mediating variables in the passenger behaviour on the service quality, customer satisfaction, and loyalty with high speed rail service. Wu *et al.* (2011) aimed to study in order to fill the conceptual gap by identifying the dimensions of service quality and empirically examining the interrelationships among the service quality dimensions, service quality, perceived value, corporate image, customer satisfaction, and behavioural intentions. Moreover, their research considered an improved understanding of passengers' behavioural intentions in the transport industry specifically in the Taiwan high-speed rail sector.

Furthermore, Joewono and Kubota (2007) established significant factors and pointed to user perceptions and priorities regarding service. Saha and Theingi (2009) examined the relationships among the constructs of service quality, satisfaction, and behavioural intentions in passengers. Eboli and Mazzulla (2012) investigated the key factors and employed SEM for analysing passengers' perceptions in terms of railway services.

These have also resulted in a robust process with adequate links between each conceptual step. In the next chapter, Transportation PPP Projects and the reasons why transportation projects are important to the stakeholders will be explored. Furthermore, the next chapter discusses User Satisfaction (US) studies on PPP and/or transportation projects.

2.11 Chapter Summary

As already mentioned in the introduction of this chapter, the relevant literature, key publications, reliable academic journal materials, and textbooks were reviewed and analysed in order to establish the need for the conceptual research study and to ensure academically proper frameworks. This means that the knowledge and concepts of PPP and BOT with the projects, Risk Assessment and Management, and Strategic Marketing Management including CS/US/SA were explored to generate an idea achieving the aim and objectives. There is a **distinctly ambitious** aspiration to improve the understanding of stakeholder satisfaction with PPP projects in order to improve Customer/User Satisfaction (CS/US) and create a learning laboratory for experimenting with possible options for improving road user satisfaction in PPP projects. Throughout the studied projects as the thesis case study research, the approaches of SD and SEM are applied as simulation implements. This is depicted in Figure 1.1: The Summary of Research Methodology Framework.

As previously mentioned, one must obtain the body of knowledge of marketing (CS) and engineering (US) concepts which link and model both SD and SEM stimulation techniques in PPP transport projects to fulfil the research questions. In other words, there are still knowledge gaps between PPP, SD, SEM, and CS/US concepts which need to be filled. Furthermore, these are part of the research study to fulfil the terms of "Modelling **User Satisfaction** with Transportation Public-Private Partnership Projects" as it is the title of this thesis as well as to attempt to attain the research questions, aim, and objectives.

In addition, this chapter presented relevant literature which informed the critical understanding of the topic. Furthermore, literature review needed to be strengthened in the areas of Customer/User Satisfaction (CS/US) studies on PPP and/or transportation projects. Empirically, preceding research studies have confirmed a direct positive relationship between Customer/User Satisfaction (CS/US) and Behavioural Intention (BI) in numerous industries including public land transport services (Parasuraman *et al.*, 1985; Parasuraman *et al.*, 1988; Oliver, 1981; 1993; 1999; Wen *et al.*, 2005; Joewono and Kubota, 2007; Chou and Kim, 2009; Oliver, 2010; Lai and Chen; 2011; Wu *et al.*, 2011; and Sumaedi *et al.*, 2012).

This has resulted in a robust process with adequate links between each conceptual step. In the next chapter, Transportation PPP Projects and the reasons why transportation projects are important to the stakeholders will be explored. Furthermore, the next chapter discusses "BTS User Satisfaction" as it is one of the case study researches with modelling by employing System Dynamics (SD).

CHAPTER THREE
TRANSPORTATION PROJECTS IN THAILAND

3.1 Introduction

The previous chapter explored the relevant literature according to the links between Public-Private Partnership (PPP) and Customer Satisfaction (CS) schemes. Additionally, this is an innovative technique in conducting research by providing a mechanism for modelling the relationship between "Service Quality" and "Satisfaction" transferring the academic knowledge from marketing, Customer Satisfaction (CS) to engineering, Road User Satisfaction (US).

This means that the constructs of Perceived Value (PV), Service Quality (SQ) and Satisfaction (SA) have been discussed and modelled. Not only are the constructs as SQ, PV and SA modelled, but the concluding model also comprise Behavioural Intentions (BI). Then, a generated idea linking between the Public-Private Partnership (PPP) concepts, Customer Satisfaction (CS) approaches, and both of System Dynamics (SD) and Structural Equation Modelling (SEM) theories is established.

In this chapter, the relevant articles linking between Public-Private Partnership (PPP) projects in Thailand are mentioned. These include the two interesting projects BTS and EXAT as case study researches.

3.2 The Link between User Satisfaction and Transportation PPP Projects

As it is titled "Modelling User Satisfaction with Transportation Public-Private Partnership Projects", this thesis aims to generate an idea to link between User Satisfaction and Transportation PPP Projects through modelling. Ideally, this encompasses the concepts of PPP and Customer Satisfaction (CS) as well as the principles of System Dynamics (SD) and Structural Equation Modelling (SEM) which have been stated previously. This chapter reviews the relevant literature connected to Public-Private Partnership (PPP) projects and/or transportation projects in terms of CS/US. As mentioned formerly, BTS

and EXAT are two PPP transportation infrastructure development projects which are researched in this study.

The aim of this research study is to improve the understanding of User Satisfaction (US) with PPP projects with a view to improved Customer Satisfaction (CS). Likewise, the aim of this chapter is to codify the body of knowledge of transportation PPP infrastructure development projects in Bangkok, Thailand. Moreover, this chapter offers the opportunity to comprehend and identify the research gaps in the body of knowledge in research publications.

Furthermore, in this thesis, academic materials and textbooks are reliable and appropriately relevant to the research subject in the area of Construction Engineering Management (CEM). This includes project risk management and marketing principles such as SQ and CS which indicate and evaluate the benefits associated with PPP projects. Similarly, these theoretical research framework aspects are established from existing literature reviews which empirically generate, develop, verify, and validate the best practice model for government policy framework.

According to the aim and objectives in this research, two transportation PPP infrastructure development projects in Bangkok, Thailand are selected. This means that the chosen BOT projects are to serve as case study researches in order to generate a model of user satisfaction. In other words, the study of the specific organisations such as BTSC and EXAT is able to assist in exploring the research aim and objectives as well as detailing the strategies of modelling user satisfaction in the following sections.

3.3 Transportation Public-Private Partnership (PPP) Projects in Thailand

Thailand successfully upgraded rural transport infrastructure, rehabilitated roads, improved road maintenance and relieved congestion. It also began to improve road safety and to reduce traffic emissions and noise. All the operations were preceded by previous projects, a number of studies, and lengthy dialogue between the banks and the government. Policy dialogue, however, was not very effective, and institutional development was modest.

Stakeholders in Thailand are to develop a satisfactory institutional and policy framework for the transport sector and make it better and more effective. From 1983 to 1996, Thailand had one of the fastest-growing economies in East Asia. This explosive growth brought with it an average seven per cent annual growth in per capita income. After three decades of rapid economic development, the economic growth of Thailand has slowed. Strengthening competitiveness has become the centrepiece of Thailand's economic policy to reinvigorate growth. Deficient infrastructure is consistently cited as a major constraint on productivity growth. To address the costs of high logistics in the transport sector, the Department of Highways (DOH) is prioritising five areas:

(i) intercity motorways;
(ii) Bangkok express ring roads;
(iii) industrial ring roads;
(iv) four-lane highway widening;
(v) roadway network connections to neighbouring countries.

The strategy of Asian Development Bank (ADB) focuses on assisting the MOT in these five areas of road development. In the longer term, ADB continues to focus on assisting the MOT in the development of the motorway network using Public–Private Partnership. Nonetheless, planning for the motorway network is not complete (ADB, 2008).

In 1941, the communication sector was reorganised to become the Ministry of Communications and steadily received further modifications to its structure during the following years. It was not until 2002, that the Reorganisation of Ministries, Government Agencies and Departments, 2002 Act came into force. It stipulated that the Ministry of Transport (MOT), the former Ministry of Communications, would have overall responsibility for transportation, and its related businesses, traffic planning, and transport infrastructure development.

At present (2016), the Ministry of Transport (MOT) is composed of the government administrations and the state enterprises as listed in Table 3.1: Government Administrations and State Enterprises under the Ministry of Transport (MOT, 2016).

Table 3.1: Government Administrations and State Enterprises under MOT

Government Administrations	State Enterprises
1. Office of the Minister 2. Office of the Permanent Secretary 3. Marine Department 4. Department of Land Transport 5. Department of Civil Aviation 6. Department of Highways 7. Department of Rural Roads 8. Office of Transport Policy and Traffic	1. State Railway of Thailand 2. Port Authority of Thailand 3. Mass Rapid Transit Authority of Thailand 4. Expressway Authority of Thailand 5. Bangkok Mass Transit Authority 6. Civil Aviation Training Centre 7. Thai Airways international Public Company Limited 8. The Transport Company Limited Traffic 9. Airports of Thailand Public Company Limited 10. Thai Maritime Navigation Company Limited 11. Aeronautical Radio of Thailand Limited 12. Suvarnabhumi Airport Hotel Company Limited 13. THAI-AMADEUS Southeast Asia Company Limited

Adopted from MOT (2016)

In addition, the Vision and Mission of MOT are delineated as follows:

Vision

"Attaining Towards Sustainable Transportation"

Mission

1. To develop transport systems, mechanism, and human resources within the organisation;

2. To formulate the Ministry's policies for development, construction, and regulation of the land, marine, and air transport systems on the basis of adequate services, accessibility, efficiency cost-effectiveness and fairness.

3.4 Transportation Public-Private Partnership (PPP) Stakeholders in Thailand

According to MOT (2016), the transport sector encompasses a wide range of infrastructure and activities. This part is organised along the three modes of transport as follows:

(i) **land transport** which includes **road**, rail, and urban;
(ii) water/marine transport; and
(iii) air transport.

Investment prospects and key issues are addressed in the context of the whole transport sector. This research study focuses mainly on the **road transport system**.

In regards to motorways, Thailand started the first inter-city route in 1998 (Bangkok – Chonburi, 81.75 kilometres) and the second one in 1999 (Eastern Outer Ring Road, 64 kilometres). The two motorways cover Bangkok and the surrounding industrial areas, serving as a commodities transport route from the northern part of the region to Laem Chabang Port. The expressway network system was limited to Bangkok and its vicinity comprising a total distance of 150 kilometres. Approximately 98.5% of the main roads and collectors road in Thailand are paved (DOH, 2016; and MOT, 2016).

The Bangkok Transit System (BTS) and Mass Rapid Transit (MRT) as well as the Airport Rail Link (the new urban rail project) are all now operational and ably serve many urban passengers including foreign travellers. The Airport Link is designed to run in parallel with the existing railway track linking the new Suvarnabhumi Airport with the city centre (ADB, 2006; BTS, 2016).

Private participation has played a crucial role in urban transport where large-scale funding is required for the mass rapid transit projects. The major projects such as the BTS and the MRT were financed by private participation (ADB, 2006).

Additionally, the Department of Highways (DOH) and Expressway Authority of Thailand (EXAT) granted concessions to private companies for toll roads and expressway projects in the form of Build-Transfer-Operate (BTO). The Don Muang Tollway is operated under a concession by DOH (Ogunlana, 1997). The other PPP project is the Second Stage Expressway, which is operating under a concession granted by EXAT (DOH, 2016; EXAT, 2016; MOT, 2016).

3.5 The Background of the Expressway Authority of Thailand (EXAT)

Thailand has suffered a great deal of economic loss due to growing traffic congestion problems. The Royal Thai Government, therefore, decided to establish an organisation to study, construct and manage expressways. The Expressway Authority of Thailand (EXAT) was then established to resolve the problem.

A state enterprise under the Ministry of Interior, the Expressway Authority of Thailand (EXAT) was established under the Announcement of the National Executive Council number 290, dated November 27, 1972. The organisation is responsible for the construction, maintenance, and management of expressways and public transportation infrastructures as well as other efforts related to expressways. The organisation was established with an aim to lighten the land transportation situation, and minimise problems and obstacles related to traffic and transportation especially in Bangkok and its vicinity (EXAT, 2016).

According to EXAT (2016), the technical term **"Expressway"** refers to newly constructed roads, either at ground level or above ground and water surfaces, and these facilitate land traffic in particular. The term encompasses roadways for monorails, subways, bridges, boat tunnels for car ferries, piers, pavements, parking lots, road shoulders, road fences, embankments, sewerages, retaining walls, kilometre signage, traffic lights and signs, and buildings associated with expressway undertakings.

In 2002, The Royal Thai government issued two royal decrees on the Government Reformation Policy:

1. A royal decree to transfer administration and responsibilities of government agencies in accordance with the Act Organising Ministries, Sub-Ministries and Departments, B.E. 2545.

2. A royal decree to amend other provisions according to the transfer of administration and responsibilities of government agencies under the Ministry of Interior. This decree transfers the administration and responsibilities of Expressway and Rapid Transit Authority of Thailand to the Ministry of Transport (MOT) as of the announcement of the decree in the Royal Gazette on October 6, 2002.

Moreover, as indicated by the EXAT strategic planning, not only has EXAT aimed to achieve a high-performance organisation of expressway business and sustainable growth with social and environmental accountability (EXAT, 2010), but EXAT has also had its Corporate Governance Guideline (EXAT, 2016).

Corporate Governance Guideline of the Expressway Authority of Thailand

The Expressway Authority of Thailand (EXAT) determines (i) to be professional in cases of services, (ii) to have social responsibility, and (iii) to insist on high ethical standards. The practical consequences of EXAT are judged by society. Consequently, the board members, directors, and members of staff should have a responsibility to society. EXAT corporate governance guideline is established for every EXAT staff including the board members and directors to insist on the practical guidance and representation of the best performance without any conflict of interests. EXAT regulates to manage the enterprise with trustworthiness, fairness, responsibility, consciousness, and consistency in the community service.

Direction

The direction of the EXAT is to achieve to be the best worthwhile journey. The aim is to be environmentally conscious and to continue to develop the EXAT facilities. These include Vision, Mission, Corporate Goals, Core Values, and Strategies.

Vision

"Worthwhile choice, advance development and to be aware of the environment"

Mission

1. To provide expressway development according to standard and safety;
2. To provide innovative and valuable services;
3. To be efficient in property management in order to enhance expressway operation ability and to be beneficial to the communities;
4. To develop management and investment systems in order to add to the organisation's value.

Corporate Goals

1. The expressways and properties will fulfil their full potential effectiveness.

2. As public confidence, “Service Quality and Safety” should be a necessity.
3. Turnover with steady growth and proper benefits.

Core Values

“Excellent service, Advanced innovation, and Clear image”

Strategies

In order to achieve the targeted vision, strategic operations are essential to be formulated. In terms of operating strategic formulations, both of the external and internal environment assessments have been analysed by using **TOWS** Matrix as a strategic formulation implement. This strategic analysis tool is constructed on SWOT analysis. The difference between TOWS and SWOT is that SWOT emphasises the internal environment whilst **TOWS** highlights the external environment at the practically realistic level. In both matrices, i.e. SWOT or TOWS analyses, the outcomes of the analysis techniques in a TOWS (or SWOT) strategy are Strengths, Weaknesses, Opportunities, and Threats. In this context, “strategy” can be defined as the art of determining how it can be won in life and business.

In each formulated strategic operation, the strengths and opportunities of the organisation will be considered to formulate the strategic operations in order to strengthen the organisation. Meanwhile, weaknesses and limitations of the organisation will also be considered in order to transform the weaknesses and limitations into strengths in future strategic operations. The EXAT strategic operations are summarised as follows:

First strategy: to improve business and service with full efficient resource usability promotion in order to generate income, enhance Service Quality (SQ), and solve traffic problems.

Second strategy: to enhance the maintenance and to maintain security and environment quality in order to reduce loses and to improve the customers, people and communities’ quality of life.

Third strategy: to improve the organisation’s management and to control in order to increase efficiency and effectiveness of operation system and enhance business abilities, the organisation’s image, and quality of life of the members of staff.

Fourth strategy: to create the expressways knowledge and innovation.

Furthermore, EXAT has had the motto as it is promoted and quoted "*Expressway Authority of Thailand: Your Buddy, Your Way"* (EXAT, 2010). "Excellent service, Advance innovation and Clear image" have been the core values that the Expressway Authority of Thailand (EXAT) continues to follow alongside its commitment since its establishment to best serve the community. The key mission is to solve traffic problems and facilitate the traffic flow of Thailand's transportation network, helping to reduce economic loss and waste while enhancing national development. The Government has appointed a special working group to study the type of "expressway" to best promote Thailand's infrastructure as well as alleviate and solve traffic problems as a result of economic, social and population expansion.

The Expressway Networks Open for Public Service

According to EXAT (2016), the Expressway Authority of Thailand (EXAT) has been established for over 38 years. There are seven expressway networks as categorised in Table 3.2 and four connecting routes of extension services as classified in Table 3.3. The eleven routes are also exemplified in Appendix A: The Map of EXAT Networks. These have been open to the public with a total length 207.9 kilometres covering the area throughout Bangkok Metropolitan Region and suburb including other nearby provinces. The traffic volume generated from the expressway is approximately 1,790,800 trips per day. This includes 1,728,400 trips a day made by 4-wheel cars. The mentioned expressways are as follows:

1. **The Chaloem Maha Nakhon Expressway** (The First Stage Expressway System) covers total length of 27.1 kilometres aiming to link the trip between the northern, southern, and eastern part of Bangkok without passing through the hub of the city. It comprises the sections as follows:

   Din Daeng-Port Section 8.9 kilometres in length links the northern part of Bangkok with the centre. It was opened to the public on October 29, 1981.

   Bang Na-Port Section 7.9 kilometres in length links the eastern part of on January 17, 1983.

   Dao Kanong-Port Section 10.3 kilometres in length links the southern part of Bangkok with the centre. It was opened to the public on December 5, 1987

2. **The Si Rat Expressway** (The Second Stage Expressway System) covers total length 38.4 kilometres aiming to link the trip between the hub of the city and the metropolitan area and connect the Chaloem Maha Nakhon Expressway as well. It forms the ring and radial expressway network comprising:

   Sector A starts from Ratchadapisek Road passing Phayathai Interchange and ending on Rama IX Road covering the length of 12.4 kilometres. It was opened to the public on September 2, 1993.

   Sector B which is regarded the main line of this expressway starts to link Sector A at Phayathai Interchange, and then connects with the Chaloem Maha Nakhon Expressway at Bangkhlo covering the length 9.4 kilometres was opened to the public on October 6, 1996. (Sector B includes collector-distributor road 2 kilometres in length from Urupong to Rajadamri Road).

   Sector C links with Sector A starting from Ratchadapisek Road to Chaeng Watthana Road. It covers the length of 8.0 kilometres and was opened to the public on September 2, 1993.

   Sector D starts from Rama IX Road to Sri Nagarindra Road covering the length of 8.6 kilometres. It was opened to the public on May 1, 2000.

3. **The Chalong Rat Expressway** (The "Ram lnthra - At Narong" Expressway and the Ram lnthra-Outer Bangkok Ring Road Expressway) covers a total length of 28.2 kilometres, starting from Ram lnthra at KM. 5.5 to "At Narong" covers the length of 18.7 kilometres. It aims to expand the expressway networks to the North and to the East. It was opened on October 6, 1996. The new expressway from Ram lnthra Road linking to Outer Ring Road connecting to Chalong Rat Expressway which covers the length of 9.5 kilometres It aims to increase the efficiency of the Chalong Rat Expressway's service and to relieve the traffic problem at Ram lnthra Road, Sukhaphibam 5 Road, Chatuchote Road, and area nearby. It was opened on March 23, 2009 which resulted in combining these two expressways into one.

4. **The Udon Ratthaya Expressway** (The Bang Pa-In - Pak Kret Expressway) covers the length of 32.0 kilometres aiming to extend the expressway network and accommodate trips to the North. The route starts from Chaeng Watthana Road to Bang Sai. It was opened to the public on December 2, 1998 and the whole route of which was opened to the public on November 1, 1999.

5. **The Burapha Withi Expressway** (The Bang Na - Chon Buri Expressway) covers the length of 55.0 kilometres aiming to accommodate the trip to the East. The route starts from Bang Na to Bang Pakong. It was opened to the public on February 7, 2000.

6. **The Bang Na - At Narong Expressway** (The third Stage Expressway System, Southern Route, and Section S1) covers the length of 4.7 kilometres aiming to link the Burapha Withi Expressway with the Chalong Rat Expressway and the Chaloem Maha Nakhon Expressway, which consequently forms the complete expressway network. It was opened to the public on June 15, 2005.

7. **The Bang Phli - Suk Sawat Expressway** covers the length of 22.5 kilometres aiming to relieve traffic problems in the areas of Bang NaTrad, Thepharak Road, Sri Nagarindra Road, Sukumvit Road, Suk Sawat Road, Rama II Road, and the area nearby including Outer Bangkok Ring Road resulting in the completion of the expressway system. It was opened to public on November 15, 2007.

Table 3.2: The Seven Expressway Networks Opened to Service

The 7 Expressway Networks	Distance (KM)
1. Chaloem Maha Nakhon (1st Expressway system stage)	27.1
2. Si Rat (2nd Expressway system stage)	38.4
3. Chalong Rat	
The Ram lnthra - At Narong Expressway	18.7
Ram lnthra - Outer Bangkok Ring Road Expressway	9.5
4. Udon Ratthaya (The Bang Pa-in - Pak Kret Expressway)	32.0
5. Burapha Withi (The Bang Na - Chon Buri Expressway)	55.0
6. Bang Na-At Narong (3rd Stage Expressway System, Southern Route, and Section S1)	4.7
7. Bang Phli - Suk Sawat	22.5
The total length of the 7 Expressway Networks	207.9

Adopted from the Expressway Networks Open for Public Service, EXAT (2015)

Table 3.3: Extension services and the areas of route alignment

	The 4 Connecting Routes of Extension Services	Route
1.	The interchange (an elevated access road) in the south of Suvarnabhumi Airport connecting with Burapha Withi (Additional entry-exit ways at Burapha Withi in support of Suvarnabhumi Airport operations)	Samut Prakan
2.	The connecting route to Kanchanaphisek (Bang Phli-Suksawat) and Burapha Withi (Additional entry-exit ways at Burapha Withi) to promote travel between Burapha Withi and Kanchanaphisek (Bang Phli-Suksawat)	Samut Prakan
3.	The connecting route at Kanchanaphisek (Bang Phli-Suksawat) and the industrial ring road (The connecting route to Chalermraj Damri 84) to the complete traffic network south of Bangkok	Samut Prakan
4.	The connecting route of Si Rat Expressway Zone D (Asoke-Sri Nakarin) and Chaturatis 61 (Part Kor) for onward travel to Chalongrat, Suvarnabhumi Airport and intercity highways No.7 (motorway).	Bangkok

Adopted from the Expressway Networks Open for Public Service, EXAT (2015)

3.6 The Background of the Bangkok Transit System (BTS) SkyTrain

On the 9th of April 1992, the Bangkok Mass Transit System Corporation Limited (BTSC), a special purpose company formed by Tanayong Public Company Limited, signed a concession agreement with the Bangkok Metropolitan Administration (BMA) to build, operate, and transfer an elevated mass transit railway system on two routes into the Centre of Bangkok. The concession was awarded by the BMA following a competitive tendering process and approval by the Ministry of Interior and the Thai Cabinet. The Bangkok Transit System (BTS) was opened and became operational in 1999. BTSC operates and derives revenue from the 23.5 kilometres railway for 30 years before handing it back to the BMA.

BTSC was established with the sole purpose of constructing and operating a mass transit railway system, on prudent commercial principles, in order to ease the increasingly severe traffic problem in Bangkok. The main objectives of BTSC are to provide a safe,

comfortable, fast, convenient, reliable, and affordable public transit system for the public and to give the shareholders of BTSC a reasonable return for their investments (BMA, 2016; BTSC, 2016).

According to BTSC (2016), BTS would result in change in travelling pattern in Bangkok. The problems of traffic and inability to arrive at destinations on time would be solved. Since travelling has an impact on economic development, BTS also affects the economic growth of Thailand. Consequently, BTS benefits were expected to be economic and social.

BTS passengers can save on travel expenses and time. As per the research conducted by BTS, the project can assist all passengers, resulting in net saving of about 15 million Baht per day. The economy will be expanded due to the increase in working efficiency resulting from reduced commuting time, and the reduced cost of solving traffic problems. The quality of life, both physical and psychological, is expected to be better. Family members would have more time to spend with each other and to rest.

This means that the project has also tried to uplift the human spirit through physical and psychological health under the concept as it is promoted and quoted ***"Lift up your life"***. In short, the project benefits the people by improving their quality of life (BTSC, 2016).

3.7 Case Study Research on User Satisfaction: The Bangkok Mass Transit System

The BTS SkyTrain project is one of the two case study researches in this thesis. The concession for the BTS was awarded to BTSC on the 9th April 1992. The BTSC was permitted to retain all revenue deriving from the system operation for 30 years. The project aims are to aid in easing the continual city traffic problems and to provide people around the central business areas in Bangkok with faster and effective modes of transportation (Tangkitsiri and Ogunlana, 2004; and BTSC, 2016).

The overlapping area from the two circles indicates the term "Satisfaction" between BTS services and the needs of stakeholders mainly focused on the BTS users. BTS is the service provider. Similarly, each relevant stakeholder in the BTS system also possesses a certain set of expectations (Tangkitsiri and Ogunlana, 2004).

If a service provided by BTS to the individual is appropriately accepted, it is likely that the recipient will be satisfied with BTS services on different aspects. The levels of satisfaction would relate to the extent of achievement of the perceived benefits. This extent of satisfaction concerns both physical and psychological aspects that can be measured through the questionnaire.

Figure 3.1 displays each condition of physical and psychological aspects by the area of intersection between BTS Services and the needs of BTS users as the User Satisfaction (US).

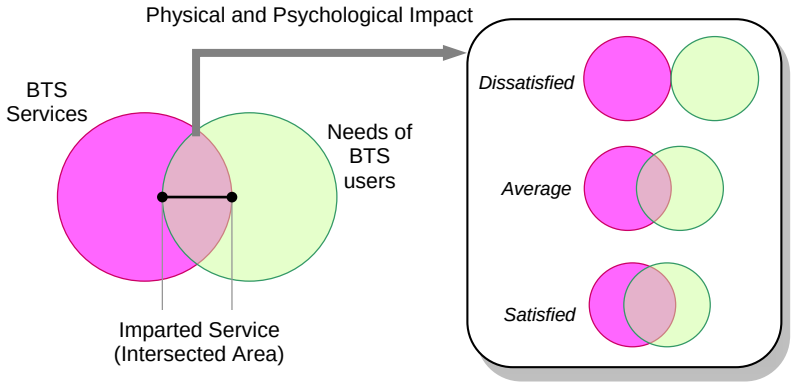


Figure 3.1: Model to Represent Levels of Satisfaction

Adopted from Tangkitsiri and Ogunlana (2004)

The Bangkok Transit System (BTS) SkyTrain has been operated by Bangkok Mass Transit System Public Company Limited (BTSC) since 1999. BTS SkyTrain is granted by the Bangkok Metropolitan Administration (BMA) as illustrated in Figure 3.2.

Furthermore, Figure 3.2 depicts the different stakeholders involved in the project. Nevertheless, the research study mainly focuses on satisfaction of BTS users since they form one of the major stakeholders and are the largest group of involved people for data collection and analysis on the project (Tangkitsiri and Ogunlana, 2004; Tangkitsiri *et al.*, 2013b; BMA, 2016; and BTS, 2016).

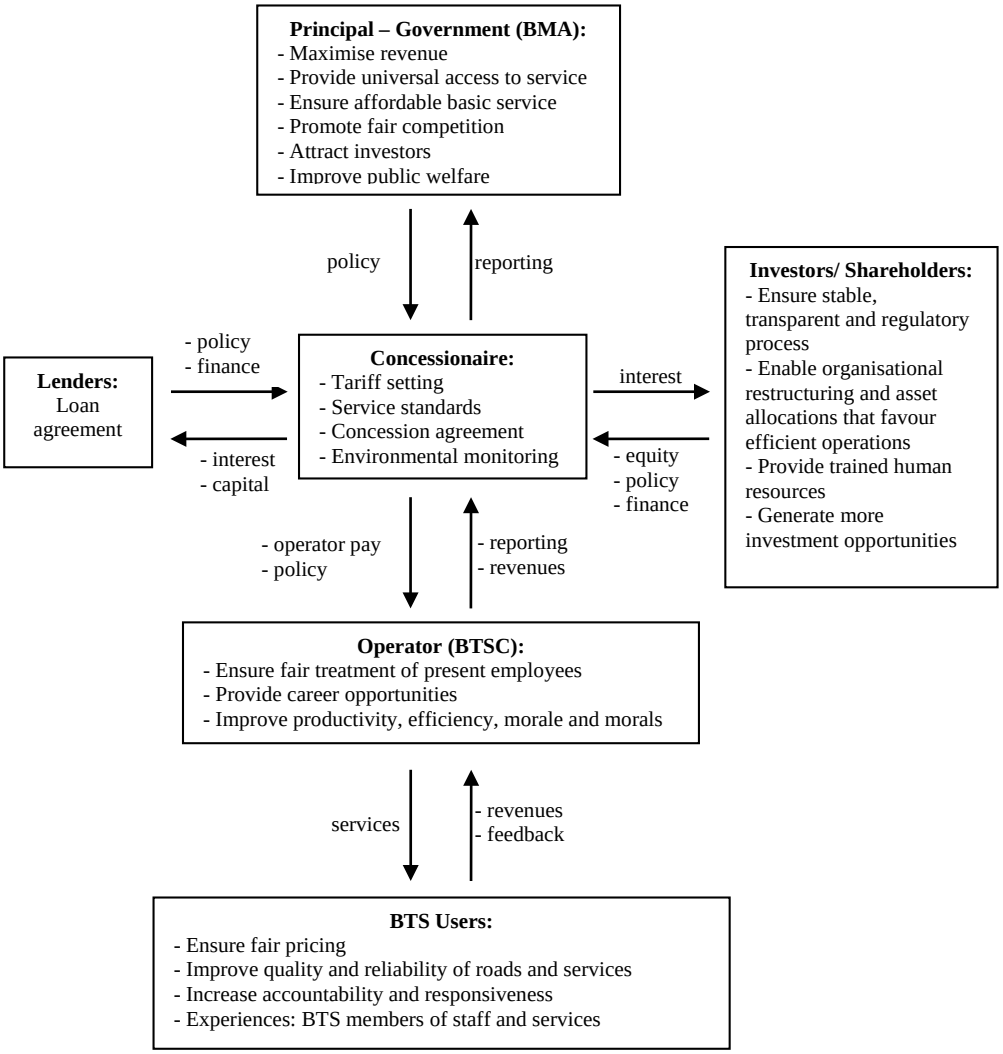


Figure 3.2: Mapping of BTS Stakeholders with its Stakeholder Satisfaction

Adopted from Tangkitsiri et al. (2013b)

Tangkitsiri and Ogunlana (2004) identified the primary factors which included service, safety and operation factors to evaluate stakeholder satisfaction with the BTS with particular reference to direct-user satisfaction. The research study was carried out via questionnaire survey as the initial data gathering approach. The survey of 757 users was conducted and reinforced with interviews with key persons on the project to evaluate the real benefits of the BTS. The results of the survey are featured in Tables 3.4 to 3.6.

Table 3.4: Demographic Profile of BTS Users in Each Age Group

Age (Years)	Male	Female	< 20	20-30	31-40	41-50	> 50
Thai	198 (32%)	429 (68%)	118 (19%)	399 (64%)	64 (10%)	34 (5%)	12 (2%)
Foreigner	65 (50%)	65 (50%)	7 (5%)	68 (52%)	40 (31%)	13 (10%)	2 (2%)

Adopted from Tangkitsiri and Ogunlana (2004)

Table 3.5: Results of Thai User Satisfaction with BTS

Factor	Very dissatisfied	Dissatisfied	Average	Satisfied	Very satisfied	Mean	SD
Service	4 (0.6%)	17 (2.7%)	149 (23.7%)	402 (64%)	55 (9%)	3.78	0.66
Safety	1 (0.2%)	10 (1.6%)	146 (23.2%)	404 (64%)	66 (11%)	3.84	0.62
Operation	4 (0.6%)	30 (4.8%)	177 (28.2%)	377 (60.1%)	39 (6.2%)	3.67	0.69
Others *(Life improvement)*	1 (0.2%)	18 (2.9%)	198 (31.6%)	337 (53.7%)	73 (11.6%)	3.74	0.70

Adopted from Tangkitsiri and Ogunlana (2004)

Table 3.6: Results of *Foreign* User Satisfaction with BTS

Factor	Very dissatisfied	Dissatisfied	Average	Satisfied	Very satisfied	Mean	SD
Service	0 (0.0%)	0 (0.0%)	14 (10.8%)	98 (75.4%)	18 (13.8%)	4.03	0.50
Safety	0 (0.0%)	1 (0.8%)	8 (6.2%)	94 (72.3%)	27 (20.8%)	4.13	0.53
Operation	0 (0.0%)	0 (0.0%)	14 (10.8%)	97 (74.6%)	19 (14.6%)	4.04	0.50
Others *(Life improvement)*	0 (0.0%)	0 (0.0%)	15 (11.5%)	85 (65.4%)	30 (23.1%)	4.12	0.58

Adopted from Tangkitsiri and Ogunlana (2004)

At the time of the survey, it was envisaged that there might be differences between the satisfaction of foreign and local users of the system. Foreign users, who were expected to have experienced other services in different countries, were expected to be more critical in rating their satisfaction with the system. Nonetheless, the outcomes indicated that foreign users have higher means for the rating of their satisfaction than local users.

The obvious conclusion from the survey is that most users were satisfied with the system. It did not translate into profit for the promoters of the BTS system; hence, the need to find ways to improve user satisfaction and to attract more users to the system.

3.8 Modelling BTS User Satisfaction Employing System Dynamics (SD)

An integration of the concepts of System Dynamics (SD) and Project Management strategies can be employed to solve a number of these problems and to analyse the outcomes. A strategic approach to Operations and Maintenance (O&M) management by employing clear strategic policies will be determined. In particular, the experience from O&M and SD should positively influence decision-making in design to ensure the satisfaction of stakeholders (Sterman, 2000; and Xu *et al.*, 2012). As a result, SD is systematically implemented as both the research methodology and the research tool for modelling (Che *et al*., 2010).

As mentioned, SD approach is applied in this study as an effective research instrument in order to generate **Causal Loop Diagram** (CLD) in readiness for simulation and policy formulation. The causal model of User Satisfaction (US) in this research study presents the interrelationships and dependencies among different variables hypothesised to explain User Satisfaction as depicted in Figure 3.3. The model presents some of the system's main feedback loops in User Satisfaction (US) in the **Causal Loop Diagram (**Figure 3.3).

It is worth stating that this focuses essentially on developing a model constructed on data from a preceding case study (Tangkitsiri and Ogunlana, 2004) and identifies different variables from the BTS questionnaire to evaluate and analyse the obvious features of the BTS project established on the primary factors of "service, safety, and operation".

The CLD is then formed as the significant model for the satisfaction of BTS users who are the largest group of respondents to the survey and having the highest impact on the BTS system. The major loops (Figure 3.3) are assembled around the major variables of satisfaction within the system namely: (i) city traffic problems, (ii) efficiency of BTS operation, (iii) level of safety, (iv) level of services provided, (v) physical/psychological health, (vi) travel cost, and (vii) travel time as this corroborates the work of Che *et al*. (2010). In addition, Figure 3.4 illustrates all the seven major variables in the causal tree within the system.

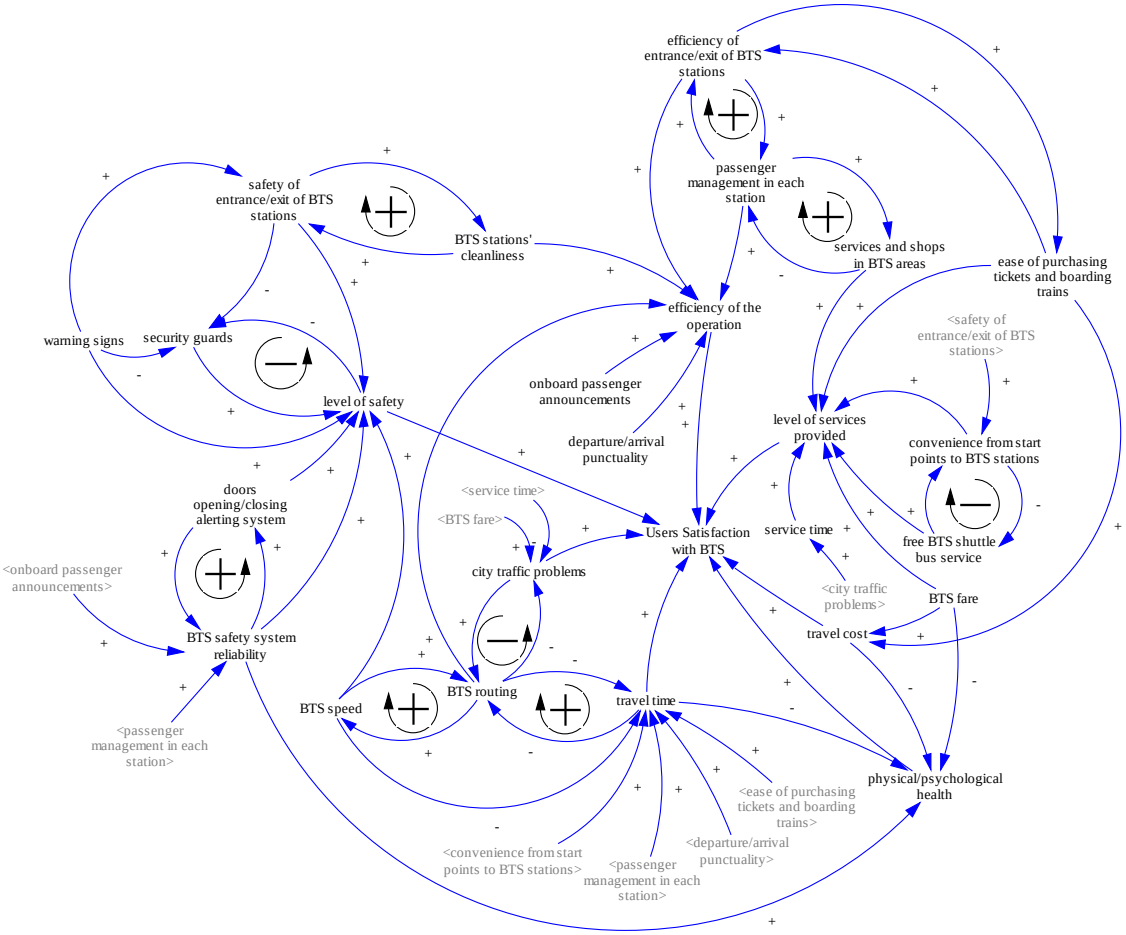


Figure 3.3: BTS User Satisfaction's Causal Loop Diagram

Adopted from Tangkitsiri et al. (2013a)

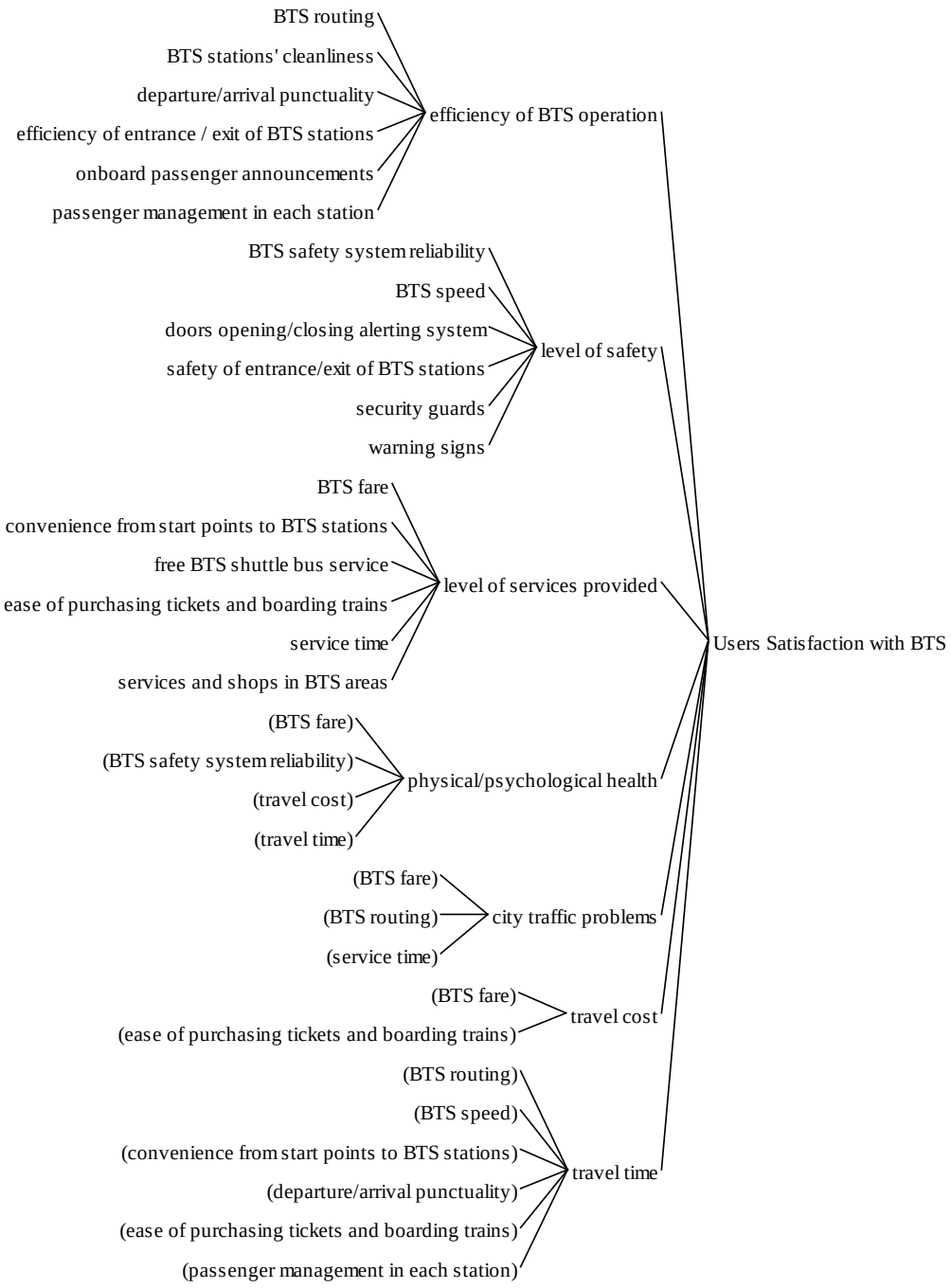


Figure 3.4: Causes Tree

Adopted from Tangkitsiri et al. (2013a)

This is, however, the preliminary model that forms the dynamic hypothesis for additional work that is being done on User Satisfaction (US). A new survey has been designed, to be supplemented with interviews with key informants/information gatekeepers on the project. The exercise would provide the necessary input data for the next stage of the model development, which is stock and flow diagrams. These would be tested and used to reproduce the reference mode provided by data on the system's performance. Once

tested and verified against available data, the model would be used to devise policies on User Satisfaction, i.e. US (Tangkitsiri *et al.,* 2013a; and BTS, 2016).

3.9 The CS/US Studies on Transportation Projects and the Models

As stated previously, the key factors, Service Quality (SQ), Perceived Value (PV), and Satisfaction (SA), have been discussed and modelled in this research. Not only are the constructs as SQ, PV and SA modelled, but the concluding model also comprise Behavioural Intentions (BI). Then, a generated idea linking between the Public-Private Partnership (PPP) concepts, Customer Satisfaction (CS) approaches, and both of System Dynamics (SD) and Structural Equation Modelling (SEM) theories is established.

The title of this research is "Modelling User Satisfaction with Transportation Public-Private Partnership Projects". This thesis aims to generate an idea to link between User Satisfaction (US) including the factors (SQ, PV, and Transportation PPP Projects by modelling and focusing on ". Hence, the aim of this research study is to improve the understanding of User Satisfaction (US) with PPP projects with a view to improved Customer Satisfaction (CS). Similarly, these theoretical research framework aspects are established from existing literature reviews which empirically generate, develop, verify, and validate the best practice model for government policy framework.

According to relevant literature review, the study strengthened in the areas of CS/US and connected to Public-Private Partnership (PPP) projects and/or transportation. In order to fulfil the research questions, aim, and objective, one must acquire knowledge of instances of marketing (CS) and engineering (US) concepts which link and model both SD and SEM stimulation techniques in PPP transport projects. In other words, there are still knowledge gaps between PPP, SD, SEM, and CS/US concepts which need to be filled. Furthermore, these are part of the research study to fulfil the terms of "Modelling User Satisfaction with Transportation Public-Private Partnership Projects" as it is the title of this thesis as well as to attempt to attain the research questions, aim, and objectives.

In addition, this section presented relevant literature which informed the critical understanding of the topic. The literature review needed to be strengthened in the areas of Service Quality (SQ) including Customer/User Satisfaction (CS/US) and studies on PPP and/or transportation projects. Empirically, preceding research studies have

confirmed a direct positive relationship between SQCS/US/SA and Behavioural Intention (BI) in numerous industries including public land transport services (Parasuraman *et al.*, 1985; Parasuraman *et al.*, 1988; Oliver, 1981; 1993; 1999; Wen *et al.*, 2005; Joewono and Kubota, 2007; Chou and Kim, 2009; Oliver, 2010; Lai and Chen, 2011; Wu *et al.*, 2011; Sumaedi *et al.*, 2012; and Kuo and Tang, 2013).

In the transportation literature review, there are a number of studies concerning Service Quality (SQ) and Satisfaction (SA). Chou and Kim (2009), Lai and Chen (2011), Wu *et al.* (2011), and Kuo and Tang (2013) focused on land transport. These research studies include road, rail, and urban especially the railway transportation sector to develop a model defining the relationship between "Customer/User Satisfaction (CS/US) and transportation projects focusing on "BOT/PPP"

Kuo and Tang (2013) studied the relationships among service quality, corporate image, customer satisfaction, and behavioural intention for the elderly in high speed rail services as displayed in Figure 3.5. This study modelled the links between Service Quality (SQ), Satisfaction (SA), and Behavioural Intentions (BI) including Cooperate Image (CI).

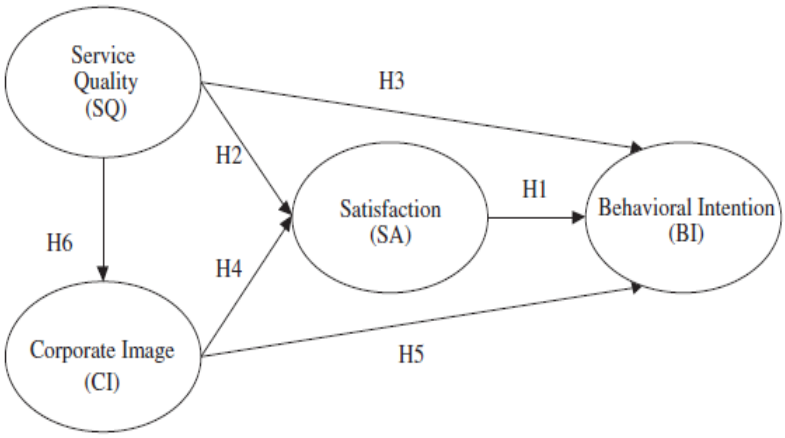


Figure 3.5: Proposed Hypothetical Model of the Travellers

Adopted from Kuo and Tang (2013)

Chen (2008) investigated structural relationships between service quality, perceived value, satisfaction, and behavioural intentions for air passengers as shown in Figure 3.6. The model is linked between Expectation as the Service Quality (SQ), Overall Satisfaction (SA), and Behavioural Intentions (BI) including Perceived Performance and Perceived Value.

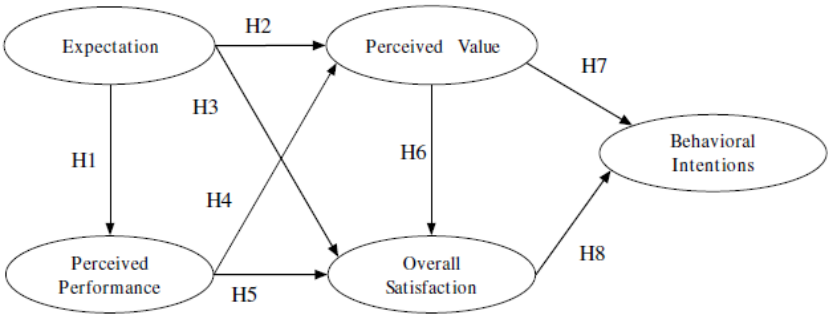


Figure 3.6: Proposed Hypothetical Model

Adopted from Chen (2008)

Additionally, Lai and Chen (2011) studied the Behavioural Intentions (BI) of public transit passengers in cases of the roles of Service Quality (SQ), Perceived Value (PV), Satisfaction (SA) and Involvement. They highlighted BI and explored the relationship between passenger behavioural intentions and the various factors (SQ, PV, SA, and Involvement) that affect them in a new public transit system as depicted in Figure 3.7.

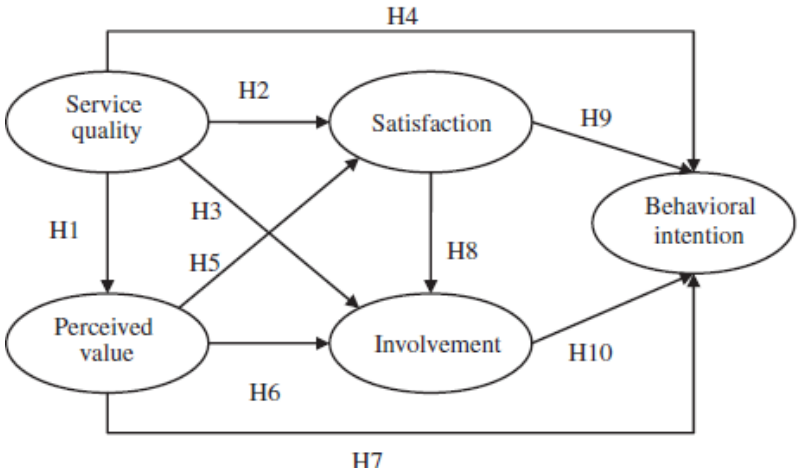


Figure 3.7: The Conceptual Model

Adopted from Lai and Chen (2011)

Sumaedi *et al.* (2012) argued that Behavioural Intentions (BI) have been discussed in depth in cases of marketing literature articles. Nonetheless, few experimental research studies have been established in transportation sectors. The empirical outcomes published that Perceived Value (PV) and Service Quality (SQ) significantly affect passengers' behavioural intention as demonstrated in Figure 3.8.

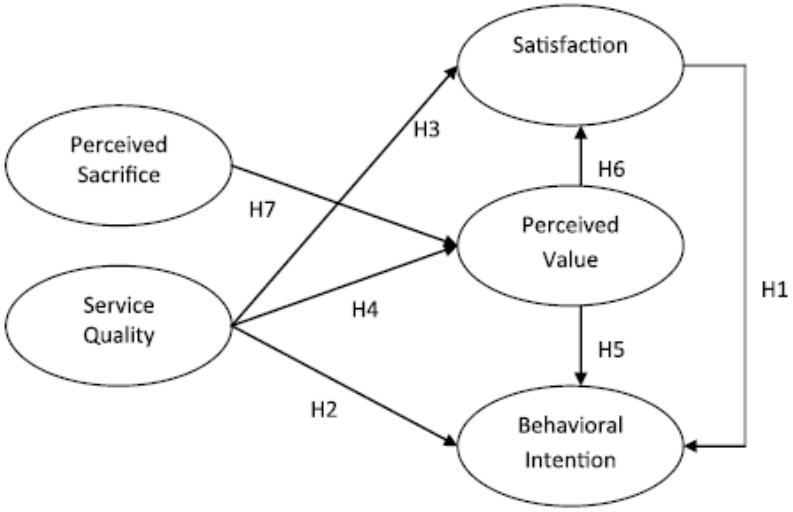


Figure 3.8: The Proposed Conceptual Model

Adopted from Sumaedi et al. (2012)

Chou and Kim (2009) measured the impact of mediating variables in the passenger behaviour on the service quality, customer satisfaction, and loyalty with high speed rail service as illustrated in Figure 3.9.

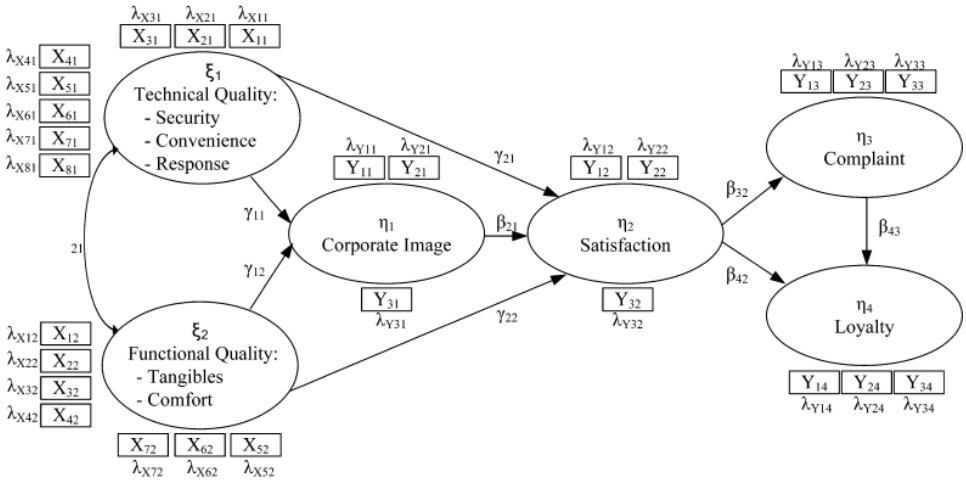


Figure 3.9: Structural Equation and Research Hypothesis Model

Adopted from Chou and Kim (2009)

Wu *et al.* (2011) aimed to study in order to fill the conceptual gap by identifying the dimensions of service quality and empirically examining the interrelationships among the service quality dimensions, service quality, perceived value, corporate image, customer satisfaction, and behavioural intentions. Moreover, their research considered an improved understanding of passengers' behavioural intentions in the transportation industries specifically in the Taiwan high-speed rail sector as presented in Figure 3.10.

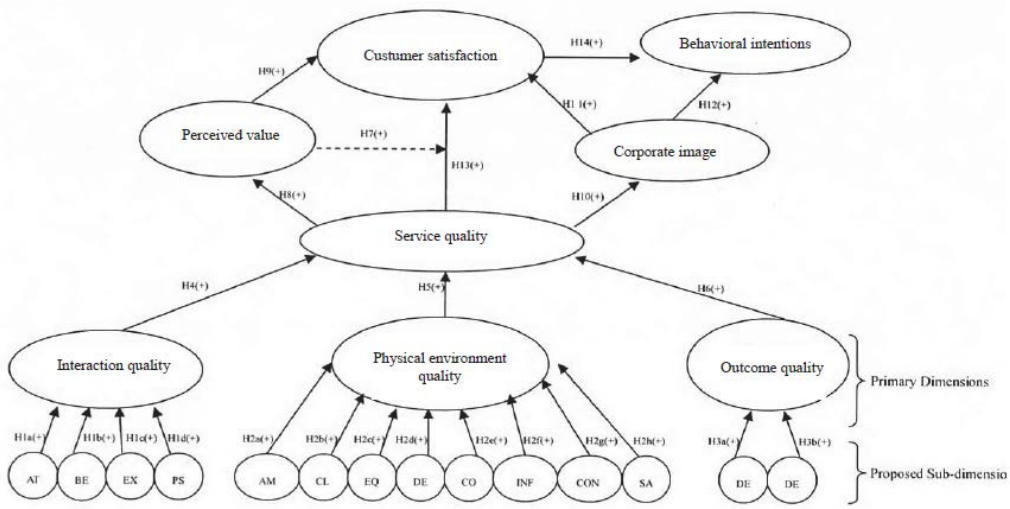


Figure 3.10: Behavioural Intentions in the Transportation Industries

Adopted from Wu et al. (2011)

Furthermore, Joewono and Kubota (2007) established significant factors and pointed to explain user perceptions and priorities regarding service as displayed in Figure 3.11.

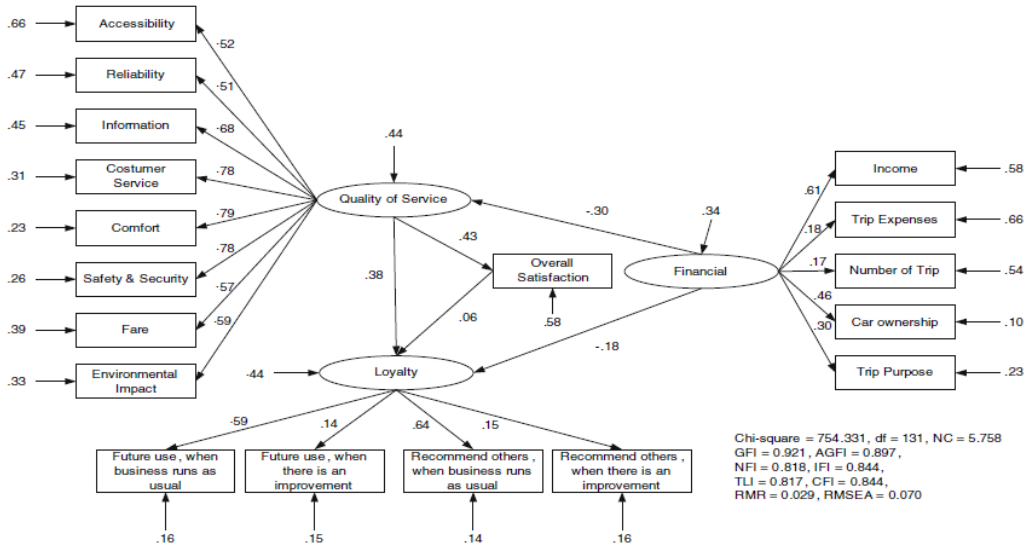


Figure 3.11: Hypotheses Testing between Constructs

Adopted from Joewono and Kubota (2007)

Saha and Theingi (2009) examined the relationships among the constructs of service quality, satisfaction, and behavioural intentions in passengers as depicted in Figure 3.12.

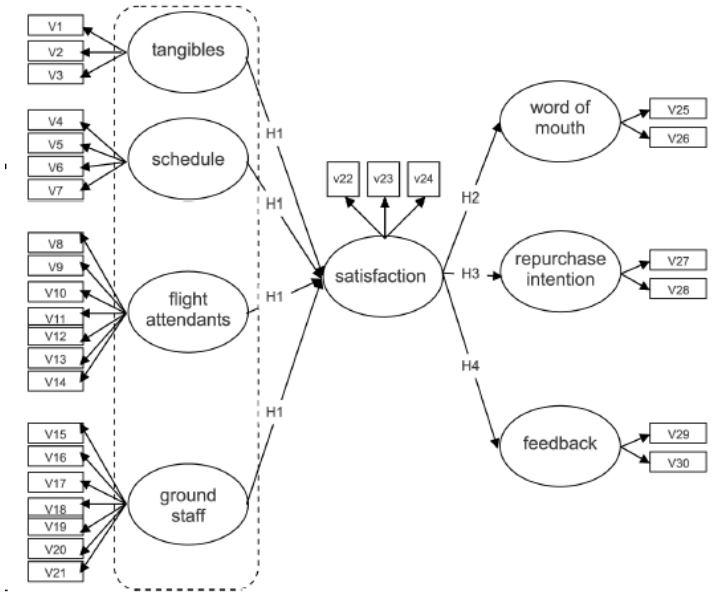


Figure 3.12: Model Specifications with Variables

Adopted from Saha and Theingi (2009)

Eboli and Mazzulla (2012) investigated the key factors and employed SEM for analysing passengers' perceptions in terms of railway services. In their research study, SEM methodology was implemented for modelling the phenomenon relating to the perception of service quality by considering unobserved latent constructs representing the main service quality characteristics, and indicators representing all the observed Service Quality factors. In the proposed model (Figure 3.13), seven latent variables named as *Safety*, *Cleanliness*, *Comfort*, *Service*, *Additional Services*, *Information* and *Personnel* were introduced. Importance and satisfaction rates were also analysed.

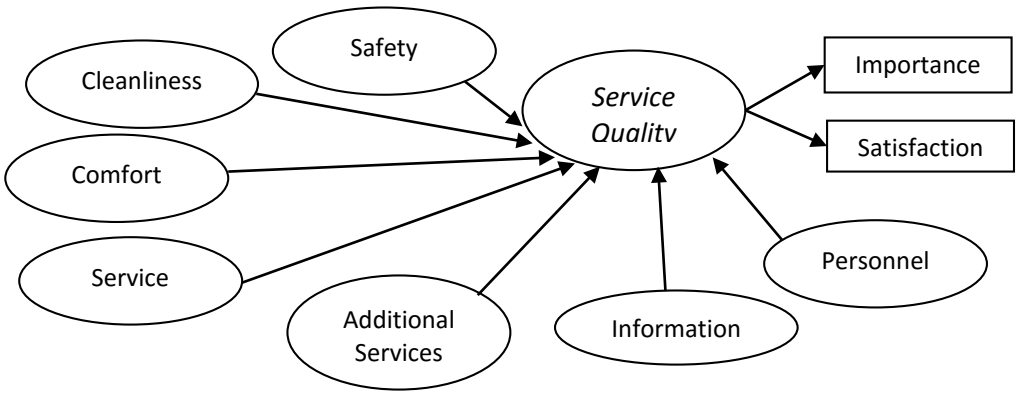


Figure 3.13: The Proposed Model between Constructs

Adapted from Eboli and Mazzulla (2012)

These are nine academic journal articles relevant to this research study. Each of them focused on CS/US in terms of PPP and/or transportation projects. It depicted the relevant literature which informed the critical understanding of the topic. Furthermore, the literature review needed to be strengthened in the areas of Customer/User Satisfaction (CS/US) studies on PPP and/or transportation projects. Empirically, preceding research studies have confirmed a direct positive relationship between Customer/User Satisfaction (CS/US) and Behavioural Intentions (BI) in numerous industries including public land transport services (Parasuraman *et al.*, 1985; Parasuraman *et al.*, 1988; Oliver, 1981; 1993; 1999; Wen *et al.*, 2005; Joewono and Kubota, 2007; Chou and Kim, 2009; Oliver, 2010; Lai and Chen, 2011; Wu *et al.*, 2011; Sumaedi *et al.*, 2012; and Kuo and Tang, 2013).

Even though the nine research articles studied on PPP and/or transportation projects, they have not yet covered road users (particular in Thailand). Only rail and air transportation projects have been researched. That is why the revised model is essential as the conceptual model.

The conceptual and practical relationship between Public-Private Partnership (PPP), Customer Satisfaction (CS), User Satisfaction (US), Marketing and Risk Management were researched to invent an innovative technique to achieve the aim and objectives. There is the distinctly ambitious aspiration to improve the comprehension of User Satisfaction (US) with PPP projects in order to improve CS and create the learning laboratory for experimenting with possible options for improving US in the PPP projects. Throughout this research study, System Dynamics (SD) Modelling and Structural Equation Modelling (SEM) have been employed as simulation tools. This means that there are still knowledge gaps between PPP, SD, SEM, and CS/US theoretical approaches which need to be completed, particularly the knowledge of instances of strategic marketing (CS) and transportation engineering (US) concepts linking and modelling both SD and SEM stimulation techniques in PPP transport projects. Finally, this research has been bridging the gap in the Academic Knowledge Transfer between marketing and engineering as well as modelling constructs in terms of SD and SEM.

3.10 Chapter Summary

In Chapter One, the development of the infrastructure projects were introduced and discussed in cases of the Public-Private Partnership (PPP) projects particularly the Build-

Operate-Transfer (BOT) method. To illustrate the point, infrastructure development and economic progress of a developing country largely depends on the availability of adequate infrastructure facilities including transportation. In order to accelerate the rate of expansion and to satisfy the increasing customer demands, the approach of Build Operate Transfer (BOT) has been introduced as a form of concession in new projects in developing countries notably in Thailand.

In addition, this is continued to state further in aspects of the PPP concepts, BOT approaches and necessities of BOTs in Chapter Two, Public-Private Partnership and Satisfaction. The benefits of the PPP projects and the transportation PPP projects with the stakeholders in Thailand were also expressed in the following chapters. This means that the greater details of the transportation projects which are important to stakeholders in Bangkok was discussed in Chapter Three. Moreover, transportation PPP stakeholders in Thailand, markedly in Bangkok as the capital city of Thailand, i.e. the participating people and organisations are presented. Furthermore, this introduced the background of the Expressway Authority of Thailand (EXAT) and the Bangkok Mass Transit System Corporation Limited (BTSC) and their projects which, as already stated, are the main crux of the research case studies. Finally, modelling BTS user satisfaction employing System Dynamics (SD) is identified as the key principle of user satisfaction. Furthermore, this research approach is to fulfil the terms of "Modelling User Satisfaction with **Transportation Public-Private Partnership Projects**" as it is the title of this thesis as well as to attempt to attain the research questions, aim, and objectives.

The next chapter of this thesis delivers an overview of research design and methodology which is detailed and employed to examine the structural equation modelling (SEM) hypotheses described in this chapter.

CHAPTER FOUR
RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

The previous chapter discussed transportation projects delivered through Public-Private Partnership (PPP) in Thailand, and the stakeholders involved in the projects. The chapter focused on the concept of PPP projects and the history of the Expressway Authority of Thailand (EXAT) and Bangkok Transit System (BTS) and used them as research case studies. The chapter discussed several theories that underpin the partnership approach, as well as critical points in evaluating large infrastructure projects by modelling BTS User Satisfaction Employing System Dynamics (SD). In addition, the chapter also examined the links and reviews of Service Quality (SQ) literature, identifying the crucial factors used in the marketing and the construction industry. The links between marketing and engineering research, in both academic and industrial fields, e.g. the BTS and EXAT projects were examined.

This chapter describes the research design and methodology which will aim to answer the research questions (1.4) and statement of the research problem (1.3) addressed in the introduction in chapter one. The research methodology has been selected as the most suitable to address the questions. The chapter also provides further analysis and description of the data needed and the methodology selected for the research study.

It is essential to comprehend both reliability and validity of content to generate a particular methodical approach in cases of SEM and the concept of “content validity” which was already mentioned in the first chapter as part of research design and methodology (1.7). The research design and methodology will take into account the need to ensure that the data used will be accurate, as discussed in chapter one.

4.2 Research Philosophy and Design

This section of the research considers the research philosophy and design as well as research approaches. Firstly, it is important that the research questions, aim, and

objectives are clearly defined. These are stated in Chapter One (1.4 and 1.5). The primary research includes quantitative, qualitative, and mixed method research studies. These are described in section 4.4. The secondary research examines the literature and relates their findings to the research questions.

The quantitative research focused on developing, collecting and analysing data in order to evaluate SQ elements of EXAT users who perceive value and are satisfied with EXAT projects and its officials. In conducting primary research to achieve the research aim and objectives, expert interviews were investigated in order to explore the strategy of the EXAT and EXAT facility users' level of perceived satisfaction. Lastly, the BTS and EXAT case study researches were considered and modelled as the valid model (base model).

The scale of satisfaction was used with a view to improve from Customer Satisfaction (CS) to User Satisfaction (US). The chapter will also present an overview of social science/engineering research studies and will discuss the philosophy of research, research design, and the assumptions adopted in social and/or engineering research (Wilson, 2012; and Creswell, 2014). Different theoretical, conceptual, and practical issues are involved in conducting and completing social research and the research findings are also presented (Saunders *et al.*, 2009; Bryman, 2012; Cooper and Schindler, 2014; and Creswell, 2014).

The definition, the word "research" can be described as the careful study or work of a particular subject which involves studying something and trying to discover facts about it especially in order to discover new facts or information about it (The Oxford Advanced Learner's Dictionary, 2016). In addition, the research establishes an activity of learning or the achievement of gaining knowledge by examining things in order to seek or revise facts, principles or theories. It justifies the truth to be believed as fact or information (Bryman and Bell, 2007; Saunders *et al.*, 2009; Jonker and Pennink, 2010; Bryman, 2012; and Cooper and Schindler, 2014).

According to Bryman (2012) and the Oxford Advanced Learner's Dictionary (2016), the word "methodology" can be stated as "a set of methods and principles used to perform a particular activity". In other words, it is able to be defined as a system of methods and principles for doing something. Hence, the selected methodology has to be constructed in such a way that it can be employed in all of the conceivable circumstances. Likewise,

"research methodology" is a way of applying clearly defined or identified methods. Researchers must be able to demonstrate that their findings are accurate. This means that they have to undertake the research aims and objectives in a variety of selective approaches. Finally, the **"research methodology"** describes the approach taken to gather the data that will then be analysed.

As a consequence, a "research design" can be stated as a grand plan of approach to the research topic. This means that the research design is the plan for fulfilling the research's aim and objectives and answering the research questions. It is essential to test the research design and to prove it to be robust prior to undertaking the research. (Saunders *et al*., 2009; Jonker and Pennink, 2010; Bryman, 2012; Wilson, 2012; Cooper and Schindler, 2014). Creswell ***(2009)*** stated that research ***designs*** are plans and procedures for research that span the ***decisions*** from broad assumptions to detailed methods of data collection and analysis. The overall decision involves which ***design*** should be used to study a topic. Informing this decision should be the ***worldview*** assumption that the researcher brings to the study; procedures of inquiry (called ***strategies***); and specific ***methods*** of data collection, analysis, and interpretation. The selection of a research ***design*** is also based on the nature of the *research problem* or issue being addressed, the researchers' personal experiences, and the respondents or audiences for the study.

Lastly, according to Jonker and Pennink (2010), when conducting research inquiries, designs, and/or surveys, researchers must have sufficient knowledge in terms of the research questions, appropriate theories, and selected and identified methodologies. Then, the researchers are able to explore their techniques in the three relevant areas of the research design relating and connecting to each other. Undertaking specific research involves the testing of theories by collecting data through the selected research methods (e.g. interviews or questionnaires), and the examination of methods carried out by the researcher informally through discussions with supervisors, audiences, and respondents) This means that the research designs are connected with the research theories, research methodologies, and research questions and contexts, as demonstrated in Figure 4.1.

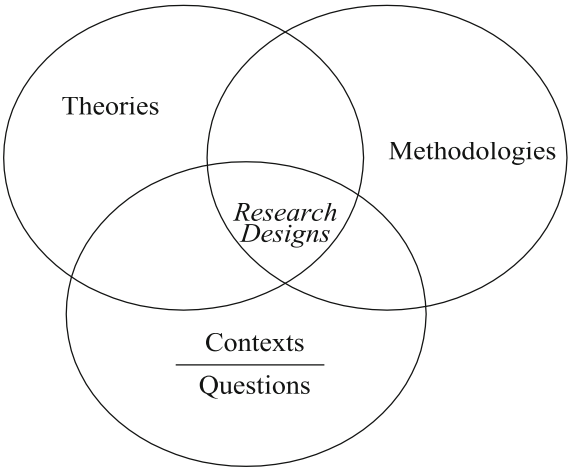


Figure 4.1: The Relationship between Research Designs and the Relevant Areas

Adapted from Jonker and Pennink (2010)

In order to justify and validate the research design, it is important to outline and verify the features of research as depicted in Figure 4.2.

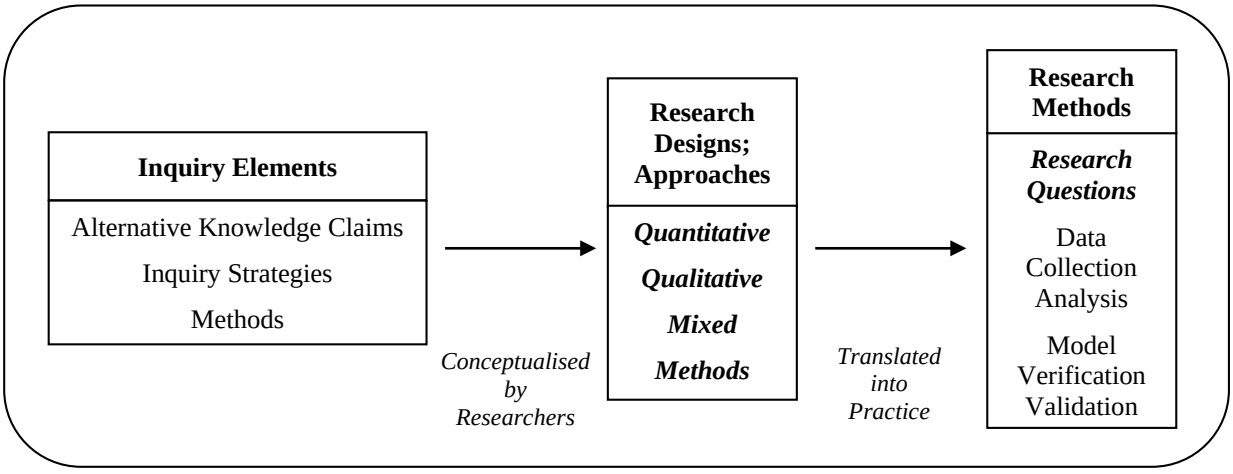


Figure 4.2: A Framework for Research Designs

Adapted from Creswell (2003; 2009; and 2014)

Research questions, as outlined in the three figures (4.1, 4.2, and 4.3), are derived from research methods that are exploratory, descriptive and explanatory, as well as the "significant principles" (hypothetical or theoretical research approaches) such as the literature review (Creswell, 2003; 2009; Robson, 2011; Cooper and Schindler, 2014; and Creswell, 2014).

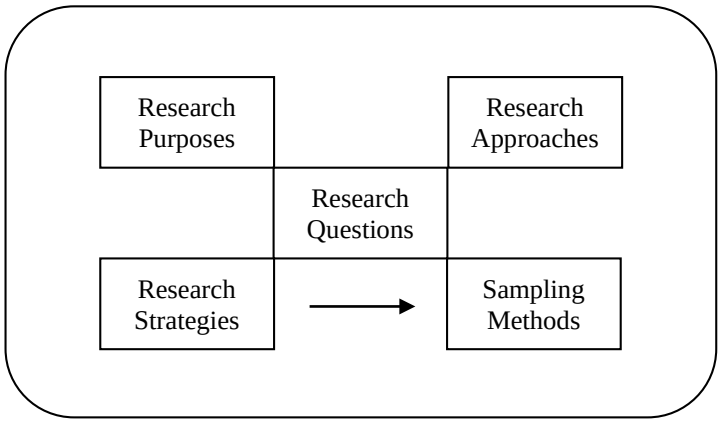


Figure 4.3: Research Purposes and the Approaches Leading to Research Questions

Adapted from Robson (2011)

If the research questions were determined, the selected choice of a proper research strategy could be made such as case studies, survey researches or experimental research strategies. In this thesis, the research questions are already stated in Chapter One Introduction (1.4). For clarity, they are:

1. Are users satisfied with Public-Private Partnership (PPP) projects? If "yes", how satisfied are they? If "no", why not?
2. Can the level of satisfaction be improved and if so how?
3. What are the real benefits that the users will gain from the PPP projects?
4. Will the projects ensure "reliability of journeys" on the roads? (In other words, the more levels of satisfaction there are, the fewer levels of risk there will be.)

Typically, sampling methods in research studies focus on observational methods, questionnaire survey sampling, interview questions, and data as well as model reviews. Consequently, the purpose-built sampling methods can also be employed individually or in combination with the research questions and designated research strategies (Creswell, 2003; 2009; Robson, 2011; Cooper and Schindler, 2014; and Creswell, 2014).

In order to justify the research design, it is important to draw a research outline of the elements of research design as shown in figure 4.2 in terms of "Research Purposes and the Approaches Leading to Research Questions" (Robson, 2011).

The conclusion of a research philosophy relies on the nature of the research problem as well as the aims and objectives of the study (Robson, 2011; Wilson, 2012; and Creswell, 2014). As a consequence, the aim for this thesis is to improve the understanding of User Satisfaction (US) with PPP projects with a view to improved Customer Satisfaction (CS). Moreover, a model for assessing the satisfaction of users has been developed.

This means that, in this thesis, the research methodology is to study the perceived satisfaction of users and officials with the EXAT project in the operational stage. Consequently, the research methodology principally conveys the concepts to design the questionnaire as the research tool and to derive the survey procedures. This study is conducted through questionnaire surveys and interviews in order to attain and maintain a perceived satisfaction model as a valid model. Similarly, this is considered in relation to qualitative, quantitative, and mixed methods (Miles and Huberman, 1994; Maxwell, 1996; Wilson, 2012; Creswell, 2014; and Sreejesh and Mohapatra, 2014).

Not only has the model for assessing the satisfaction of users been developed, but the following objectives have also been set for the research by identifying and evaluating the benefits associated with PPP projects in Thailand. According to the aim and objectives for the research studies, a model of user satisfaction with PPP by using data based on the BTS and EXAT case studies has been generated. The model to determine user satisfaction on PPP projects was also developed. Then, the developed model was developed from the Verification and Validation (V&V) of the SEM model by interviewing the experts including senior experts particularly in the Ministry of Transport (MOT) in Thailand.

4.3 Research Approaches

When choosing research approaches, researchers must decide on the logical research philosophy that will build the understanding of the phenomena under investigation. There are two common kinds of research approaches; deductive and inductive (Creswell, 2009; Saunders *et al.*, 2009; Robson 2011; Cooper and Schindler, 2014; and Creswell, 2014). By way of summary from a variety of sources (mainly Creswell, 2009; Saunders *et al.*, 2009; Robson 2011; Cooper and Schindler, 2014; and Creswell, 2014). The deductive approach is used to express a method of reasoning where conclusions are deduced logically

from other circumstances that are already known. This is based on logical or reasonable deduction. In other words, the deductive method refers to a dominant research in the natural sciences. The approach involves generated plans in the forms of hypotheses from existing research theories, testing the operational hypotheses in the real world, and examining the specific outcome of the inquiry elements. The inductive approach is a form of reasoning in which a generalised conclusion is formulated from exact and specific situations. This approach connects to the process of deriving common basic principles and assumptions from specific evidences or cases. The inductive method is also an approach to the relationship between theories and studies in research. This includes generalisation or theories from categories and generalisation improvement or theories from preceding experiences or articles (Creswell, 2009; Saunders *et al.*, 2009; Robson 2011; Cooper and Schindler, 2014; and Creswell, 2014). These two approaches are also shown in Figure 4.5 as it is "A Cross Section of Philosophical Worldviews in Research". This figure is also adapted from Creswell (2003; 2009; and 2014), Robson (2011), and Saunders *et al.* (2009).

For decades, investigators or inquirers have had a wide range of research approaches and views and/or ideas of the designation of the methodologies of research studies. For designing a proposal or a plan, it is recommended to normally develop a framework to be available for applying the research study. In addition, it supplies guidance on the study by assessing the philosophical concepts behind the inquiry in order to proceed with the detailed data collection and analysis (Creswell, 2003; Saunders *et al*., 2009; Jonker and Pennink, 2010; Robson, 2011; Bryman, 2012; Wilson, 2012; Cooper and Schindler, 2014).

Creswell **(2014**), furthermore, argues that research **approaches** are plans and procedures for research that span the **steps** from broad assumptions to detailed methods of data collection, analysis, and **interpretation**. This plan involves several decisions. The overall decision involves which **approach** should be used to study a topic. Informing this decision should be the **philosophical** assumptions the researcher brings to the study; procedures of inquiry (called **research designs**); and specific **research methods** of data collection, analysis, and interpretation. The selection of a research **approach** is also based on the nature of the research problem or issue being addressed, the researchers' personal experiences, and the audiences for the study.

In addition, Creswell (2014) and Sreejesh and Mohapatra (2014) stated that qualitative approaches best suited to situations where the existing knowledge base of the

phenomenon under investigation is limited. Quantitative methods, on the other hand, are used to identify and analyse the outcome of the questionnaire survey. These approaches include the decision factors, formulated hypotheses, risk factors associated with outsourcing, and service quality assessment of outsourced services. It is expected that the outcome of this will form the foundation for the construction of the framework as shown in Figure 4.2: A Framework for Research Designs which is also adapted from Creswell (2003; 2009; and 2014).

In conclusion, as identified by Creswell (*2009*; **2014**) and Figure 4.2, it is found that a "*research design*" or "**research approach**" is the plan and procedure for research crossing the *decisions*/**steps** from general hypotheses to discussed schemes in details of data collection and analysis. It can also be characterised into qualitative, quantitative, and mixed methods. This is why the frameworks exist for designing a proposal (Miles and Huberman, 1994; Maxwell, 1996; Robson, 2011; Creswell, 2014; and Sreejesh and Mohapatra, 2014). Even though there are different types of designs and terms used to describe them in the literature, they can be categorised by the three approaches of research design which are:

1. ***Quantitative Methods*** have already been available to the "social science" and/or "social engineering" for a number of years. Not only has this initially been developed in the natural sciences to study natural phenomenon, but this is also suitable for the situation that the current knowledge base of the phenomena under the limited examination. In other words, quantitative research is an approach for testing objective theories by examining the relationship among variables. These variables are measured or implemented in this research. As a consequence, the collected data can be analysed using statistical theories and techniques. Furthermore, quantitative research techniques can also be employed to determine and analyse the questionnaire survey outcome including formulated hypotheses and the relevant factors, i.e. SQ, PV, SA, and BI.

2. ***Qualitative Methods*** have been developed principally during the last three or four decades. The research studies explore the research problems that occur in practical issues through qualitative approaches. Correspondingly, the qualitative methods, e.g. interviews or pilot tests, are suitable for understanding

the meanings which contextualise human experiences involved in the phenomena such as values, beliefs, actions, or decisions under the social worldviews. This means that the qualitative research is the approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The research process includes developing inquiries and measures, data collected and analysed inductively constructing from details to common questions, and making interpretations of the data/model implications. Similar to quantitative research methods, these include the form of inquiry and support how to research as the inductive approach.

3. ***Mixed Methods*** are still brand new and are being cultivated in form and substance. Mixed methods research is an approach to inquiry that combines a qualitative and quantitative approach in one research design. This technique involves philosophical/worldview assumptions, the use of qualitative and quantitative methods, and the mixing of both methods in a research study. This means that not only is this approach of research design about more than just collecting and analysing both kinds of data, but includes the use of both approaches in tandem. Hence, the overall strength of the study is greater than either qualitative or quantitative research approaches on their own. In this study, quantitative and qualitative research approaches are combined as "mixed methods". The combination of a questionnaire survey for collecting and analysing data and interviews for verifying and validating a model is implemented. This section therefore explains the population and sample units for this study as well as the sampling technique adapted to distribute copies of the questionnaire after determining the sample size. It also elucidates the design of the questionnaire for the survey and interview questions for the case study.

These are also mentioned and illustrated in Figure 4.2: A Framework for Research Designs which is adapted from Creswell (2003; 2009; and 2014). As stated by Creswell (2019; **2014**), these definitions of research approaches have considerable information in each one of them. The significant components in each definition are the approaches to research involving worldview or **philosophical** assumptions with distinct methods or procedures. It is called "the three components involved in a design or **an approach**". Correspondingly, the research design or **the broad research approach** is referred to as the plan or proposal to conduct research. This involves the intersection of philosophy,

strategies of inquiry (or **research design**), and specific methods. The research framework is used to explain the interaction of these three components as already elucidated in figure 4.2 as “A Framework for Research Designs”.

4.4 The Relationship between Qualitative and Quantitative Research Methods

As formerly established in research approaches (4.3), the researchers have to make a decision to select from the philosophical research approaches, i.e. deductive and inductive. This is defined as the research techniques (and procedures) of supporting and building the understanding of the examination phenomena. This is also demonstrated in Figure 4.5: A Cross Section of Philosophical Worldviews in Research (Creswell, 2003; 2009; Saunders *et al.*, 2009 Robson, 2011; Cooper and Schindler, 2014; and Creswell, 2014).

Even though there are divergent research philosophies used in literature reviews, it can be categorised by three methods of research designs (or approaches). Hence, the three research designs (or approaches) are (i) Quantitative Methods; (ii) Qualitative Methods; and (iii) Mixed Methods (Miles and Huberman, 1994; Maxwell, 1996; Robson, 2011; and Sreejesh and Mohapatra, 2014).

According to Creswell (2003; 2009; and 2014), the third major element in the framework is the specific **research methods** that involve the forms of data collection, analysis, and interpretation that researchers propose for their studies. As shown in Table 4.1 and Figures 4.2 and 4.5, it is beneficial to consider the full range of possibilities of data collection and to organise these methods.

Table 4.1: The Research Designs of Qualitative, Quantitative, and Mixed Methods

Qualitative Methods	Quantitative Methods	Mixed Methods
• Emerging methods • Open-ended questions • Interview data, observation data, document data, and audio-visual data • Text and image analysis • Themes, patterns interpretation	• Pre-determined • Instrument based questions • Performance data, attitude data, observational data, and census data • Statistical analysis • Statistical interpretation	• Both pre-determined and emerging methods • Both open- and closed-ended questions • Multiple forms of data drawing on all possibilities • Statistical and text analysis • Across databases interpretation

Adapted from Creswell (2003; 2009; and 2014)

The philosophical worldviews have had to conceptualise advocating distinctly between the use of **qual**itative methods and **quant**itative methods (Kent, 1999; Kotler and Keller, 2006; Kent, 2007; Kolb, 2008; Saunders *et al.*, 2009; Wilson, 2012; Cooper and Schindler; 2014; Creswell, 2014).

In the marketing field, the qualitative approaches most frequently employed are (i) interviews and (ii) focus groups. These two techniques are extremely relevant to different research purposes, questions, aims, objectives, and types of data required. Interviews offer opportunities to attain sufficient and perceptive pieces of research information. Interviews are allocated into three major categories: (i) in-depth, (ii) interception, and (iii) expert interviews (Kent, 1999; Kotler, 2002; Kotler and Keller, 2006; Kent, 2007; Kolb, 2008; Wilson, 2012; and Belk, 2013).

First of all, "in-depth" interviews are employed to collect information about a participant's views or knowledge on a specific issue. The researchers are able to explore the first response of participants by means of added and follow-up questions resulting in the in-depth information acquired. Concurrently, interviewees have adequate time to fully develop their attitudes and express their ideas in their own words. Consequently, information tends to have more value (Hague, *et al.*, 2004).

Secondly, "inception" or "person-on-the street" interviews are short interviews due to time constraints of participants. Research topics and information obtained are therefore limited.

Lastly, “expert” interviews differ from in-depth interviews in that these participants are not current or potential consumers, yet they are the ones who have specific knowledge according to the research area such as the industry, companies, or organisations. Frequently, the expert interviews contribute greatly to the initial stages of the research as the information assembled might assist to support researchers and/or their research’ hypotheses to indicate research problems. Correspondingly, the expert interview approach may have subsequently been achieved in the final steps of the researches in order to reinforce information as well as to authorise the research outcomes (Kent, 1999; Kotler, 2002; Kotler and Keller, 2006; Kent, 2007; Kolb, 2008; Wilson, 2012; and Belk, 2013).

In this thesis, the expert interview approach has been adapted as part of the research design in the forms of “Mixed Methods”. The expert interviews have been attained in the concluding phase of this research in order to achieve the thesis research questions, aim, and objectives as well as to authorise the SEM model as the research findings.

According to Yin (2011), mixed methods research offers an option that actually tries to take advantage of the similarities and differences in qualitative and quantitative methods. In this research, quantitative and qualitative research approaches are combined as the “mixed methods” and publicised in Figure 4.2: A Framework for Research Designs and Figure 4.5: A Cross Section of Philosophical Worldviews in Research.

Figure 4.4 displays the approach to combining “qualitative” and “quantitative” methods in one research design (Jonker and Pennink, 2010). In other words, the combination of (i) a questionnaire survey (for collecting and analysing data) and (ii) interviews (for pre-testing, piloting, verifying, and validating a model) is implemented (Saunders *et al.*, 2009; Yin, 2011; Wilson, 2012; Cooper and Schindler; 2014; and Creswell, 2014).

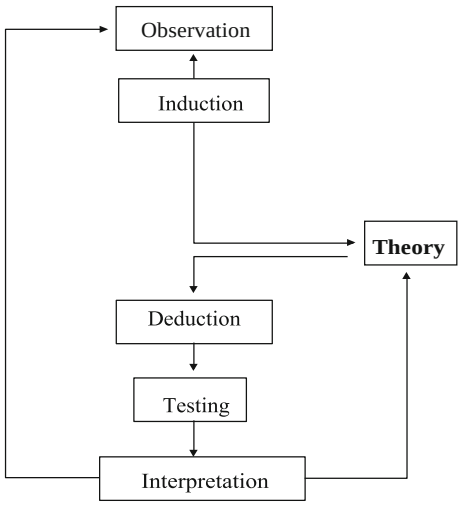


Figure 4.4: Combining Qualitative and Quantitative Approaches

In order to measure and model the levels of satisfaction of EXAT users and officials as the significant stakeholders, **quantitative research methods** have been used. The results relate to the expected criteria, as perceived by the users. Correspondingly**, qualitative research methods** have also been employed as part of the research design. Both of the **quantitative and qualitative** research methods are combined in forms of **mixed methods**.

A verified and validated model produces a valid model (base model). Then, the model can identify and evaluate the benefits associated with PPP projects in Thailand and/or other developing countries (Cronin *et al.,* 2000; Tangkitsiri and Ogunlana, 2004; Olorunniwo *et al.,* 2006; Chen, 2008; Lai and Chen, 2011; Sumaedi *et al.,* 2012; Kuo and Tang, 2013; Tangkitsiri *et al.,* 2013b).

4.5 Research Strategies and Sampling Methods

As previously quoted in Research Philosophy and Design (4.2) and Research Approach (4.3), Creswell (***2009***) mentioned that research ***designs*** are plans and the procedures for research. Informing this decision should be the ***worldview*** assumptions the researcher brings to the study; procedures of inquiry (called ***strategies***); and specific ***methods*** of data collection, analysis, and interpretation. Creswell **(2014)** argued that research **approaches** are the plans and procedures for research. Informing this decision should be the

philosophical assumptions the researcher brings to the study; procedures of inquiry (called **research designs**); and specific **research methods** of data collection, analysis, and interpretation.

The available evidence clearly leads to the conclusion found by Creswell (***2009***; and **2014**) that the plans and the procedures for research are either the research ***designs*** or **approaches. T**he ***worldview*** assumptions mean the **philosophical** assumptions. The procedures of inquiry can also be called ***strategies*** or **research designs,** and the specific ***methods*** refer to the specific **research methods.** These are also presented in Figure 4.2: A Framework for Research Designs and Figure 4.5: A Cross Section of Philosophical Worldviews in Research. Saunders *et al*., (2009) commented that research strategies are assessed and considered as part of "Philosophical Worldviews" in Research. Consequently, there are seven categories of research strategies in terms of management research studies. These are: (i) experiment; (ii) survey; (iii) case study; (iv) action research; (v) grounded theory; (vi) ethnography; and (vii) archival research. Additionally, there are philosophical world views as demonstrated in Figure 4.5 "A Cross Section of Philosophical Worldviews in Research" which is adapted from Creswell (2003; 2009; and 2014), Robson (2011), and Saunders *et al.* (2009).

From the categories of the research strategies, this research study implements case study and survey research led by the research questions, aim, and objectives. This is expressed in the two following sections, i.e. 4.6 Case Study Research and 4.7 Survey Research consecutively.

According to the research questions and strategies, sampling methods concentrate on observational methods, questionnaire survey sampling, interview questions, and data and model reviews. These are also publicised as "data collection and analysis" and "model verification and validation (V&V)" in Figure 4.2 as part of the framework for research designs and Figure 4.5 as part of research method.

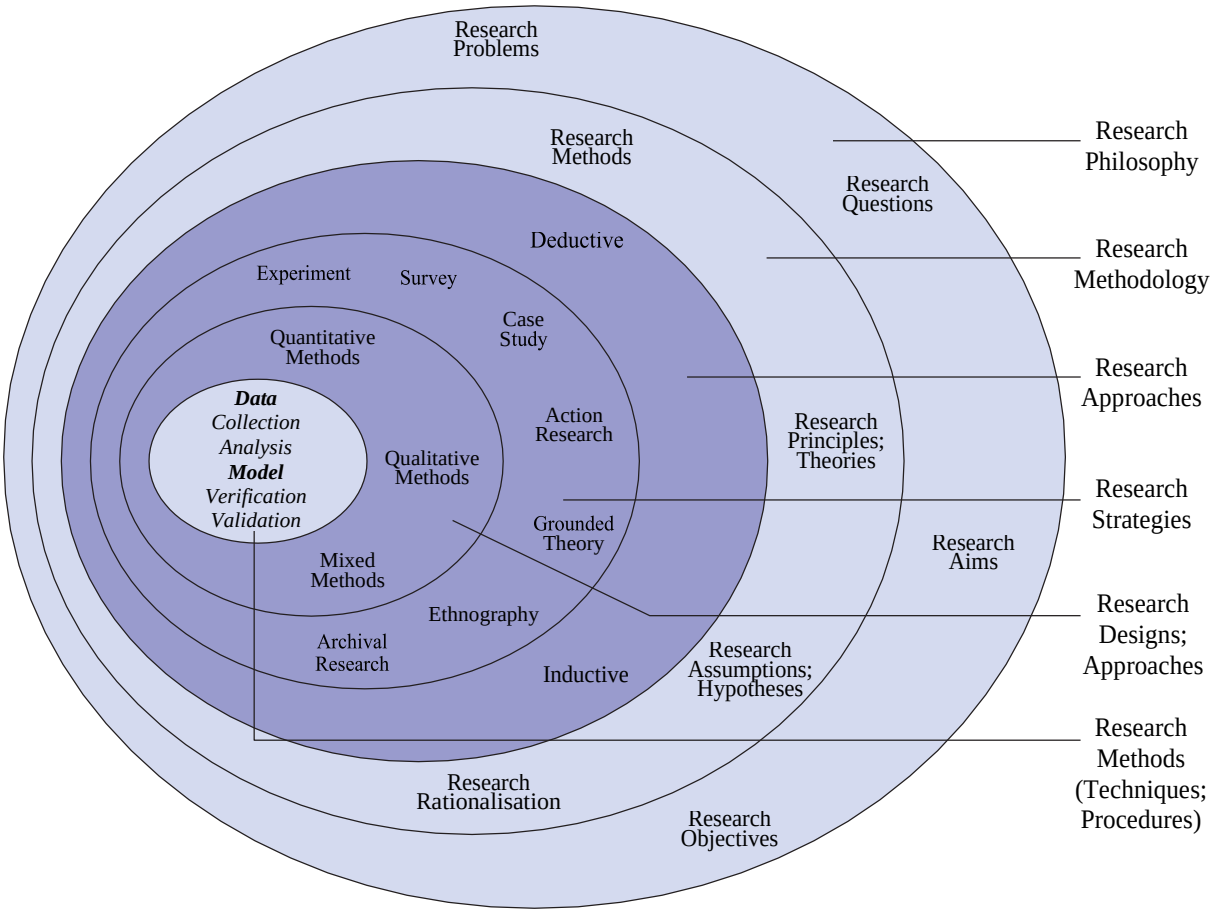


Figure 4.5: A Cross Section of Philosophical Worldviews in Research

Adapted from Creswell (2003; 2009; and 2014), Robson (2011), and Saunders et al. (2009)

The selection for sampling is essential to the success of the research as it is relative to the accuracy of the data. A sampling method is defined as the way of identifying, choosing, and accessing relevant respondents. The sampling methods can also be employed individually or in combination with the research questions and designated research strategies. They provide a range of techniques that can help to reduce the amount of data needed for collection by considering only data from a sub-group rather than all possible cases or elements. Typically, sampling methods in research studies focus on observational methods, questionnaire survey sampling, interview questions, and data as well as model reviews. Consequently, the purpose-built sampling methods could also be employed individually or in combination according to the research questions and designated research strategies (Kent, 1999; Kotler and Keller, 2006; Kent, 2007; Kolb, 2008; Saunders *et al.*, 2009; Wilson, 2012; Cooper and Schindler; 2014; Creswell, 2014).

Similarly, these are already stated in the former sections, i.e. “4.2 Research Philosophy and Design and 4.3 Research Approach” and displayed in figure 4.2 and figure 4.3 as well. The research questions in this research are already stated in Chapter One Introduction (1.4). They are also settled as the key issue to determine in terms of the perceived satisfaction levels of EXAT users and officials being accomplished.

In order to achieve the research strategies and sampling methods including survey methods, the link between the research design, approach, and methodology as well as conceptual and practical theories have to be established. This is also displayed in Figure 4.1. These research strategies are supported by research techniques for collecting and analysing the data as well as verifying and validating the model (Jonker and Pennink, 2010).

According to Saunders *et al.*, 2009, the number of cases from which a sample is taken is called the population. Questionnaires are launched to collect data from the entire population, yet only a sample of the data collected is analysed. Many researchers argue that using sampling makes a higher overall accuracy rate possible. In addition, Saunders *et al.* (2009) mentioned in an overview of sampling methods that sampling techniques can be divided into two types: (i) probability or representative sampling; and (ii) non-probability or judgemental sampling. The “probability sampling” or “representative sampling” is employed in this research as part of the research strategy, sampling methods, and research methods. Not only is it most frequently related to survey-based research strategies, but it is also essential to consider the sample of a population to answer the research questions and/or to attain aims and objectives. There are four phases in the process of the probability sampling. The four stages are:

1. Identifying a suitable sampling frame based on research questions or objectives.
2. Deciding on a suitable sample size.
3. Selecting the most appropriate sampling technique and selecting the sample.
4. Checking that the sample is representative of the population.

Evidence from the extant literature show “Research Strategies” and “Sampling Methods” could be combined into Research Methods (Kent, 1999; Creswell, 2003; Kotler and Keller, 2006; Kent, 2007; Kolb, 2008; Creswell, 2009; Saunders *et al.*, 2009; Robson, 2011; Wilson, 2012; Cooper and Schindler; 2014; Creswell, 2014).

Furthermore, Saunders *et al*. (2009) argued that caution should be used in research studies when reading a wide range of research books and articles. These are "research method" and "research methodology". These two key terms can be employed interchangeably, yet using "methodology" as a more verbose way of stating "method". In this thesis, the key term **"research methods"** refers to **"research techniques and procedures"**. Research methods are used for data collection and analysis. These include questionnaires (surveys) and interviews as well as both quantitative (statistical) and qualitative (non-statistical) analysis techniques, e.g. Model Verification and Validation (V&V). On the other hand, the key term "research methodology" refers to the theory of how research should be undertaken when deliberating a range of philosophical assumptions. This means that a "research methodology" is a way of applying clearly defined or identified methods. In other words, the **"research methodology"** is the reasonable method in justifying the rationalisation of research approaches in a proper way. These are demonstrated in Figure 4.2 (A Framework for Research Designs) and Figure 4.5 (A Cross Section of Philosophical Worldviews in Research).

Each research strategy and method can be employed for exploratory, descriptive, and explanatory research studies (Yin, 2009; and 2014). Some of these clearly belong to the deductive approach, while others belong to the inductive approach. Similarly, this research study is **deductive** since it has already had the research theories including the concepts of PPP/BOT, SD/SEM, and SQ/SA.

Even though there were the interviews of EXAT experts as part of the key stakeholders, these pieces of information could only support and answer the research questions, aim, objectives, and the SEM model. The model Verification and Validation (V&V) is derived from and authorised by the interviews of EXAT experts who are part of the key stakeholders (AIAA, 1988; LANL, 2004; and Pace, 2004). This means that the model is considered to be a valid model (base model) to identify and evaluate the benefits associated with PPP projects in Thailand and/or other developing countries.

4.6 Case Study Research

Before examining case studies as a form of research it is important to understand what a case study is. The Oxford Advanced Learner's Dictionary (2016) states that a "case study" is "a detailed account of the development of a person, a group of people or a

situation over a period of time". According to Creswell (2009; and 2014), "a case study is a qualitative strategy in which researchers explore in-depth a programme, event, activity, process, or one or more individuals. The cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time" (Yin, 2009; 2011; and 2014). Case studies, can also be defined as a strategy for conducting research associated with empirical inquiries of a particular contemporary phenomenon within its real life context using multiple sources of evidence (Yin, 2009; Robson, 2011; and Yin, 2014).

The appropriate selection of the research strategies are informed by the research questions and the aim and objectives. The use of case studies in this research strategy aims to study the implementation of the transportation PPP infrastructure development projects in Thailand. The "Case Study Research" is selected as mentioned formerly in order to measure and model the levels of perceived satisfaction of EXAT users and officials. Two transportation PPP infrastructure development projects in Thailand were selected for case study research in order to generate a model of user satisfaction. In other words, studying specific organisations such as BTSC and EXAT means that detailed strategies of modelling user satisfaction can be achieved

The importance of Service Quality (SQ) elements towards Satisfaction (SA) can also be measured as the data is quantifiable and comparable. Furthermore, this research approach is used to measure Perceived Value (PV) and Behavioural Intentions (BI). Hence, the case study research strategy seems to be applicable for investigating SQ elements guided by the research questions and objectives. This research strategy can reflect on the components of PV on SA and BI via SQ. In order to obtain the understanding of SA and BI from the user perspective, the research strategies and SQ elements are explored. This assesses how the users and officials perceive the outcome of the projects.

Case study research aims to study a phenomenon (the "case") in its real world context. A case study may rely on quantitative or qualitative data (or both) yet usually involves some field-based data (Yin, 2009; 2011; and 2014).

Case study research includes describing, exploring, and controlling the subject under investigation such as a person, organisation, community or country (Woodside and Wilson, 2003). Furthermore, the case study research in the marketing field delivers

opportunities to marketers. For example, it helps to examine marketing problems which tend to generate a lack of interest in theory building research (Bonoma, 1985). Even though the case study may rely on quantitative or qualitative data (or both), this research strategy may be constructed by qualitative research as it can give rich and in-depth information appropriate for management situations and other contextual data (Yin, 2009; 2011; and 2014).

4.7 Survey Research

According to Saunders *et al*., (2009) and Figure 4.5: A Cross Section of Philosophical Worldviews in Research, there are seven types of research strategies in metaphysical research studies. These research strategies include case study research (4.6) and survey research (4.7) consecutively. From the research strategy categories, this section performs "survey research". In other words, the appropriate use of research strategies in order to achieve the aims and objectives of the research study. It is also moderately conceivable to carry out the survey strategy as part of a case study research (Saunders *et al*., 2009). This can involve surveying different stakeholder groups within a project as in Awakul and Ogunlana (2002).

A "survey" is an investigation of the opinions and/or behaviour of a particular group of people usually done by asking them questions (The Oxford Advanced Learner's Dictionary, 2016). As a result, "survey research" is a measurement process using a highly structured interview. Survey research strategy employs a measurement tool called *questionnaire*, *measurement instrument/device*, or *interview schedule* (Cooper and Schindler, 2014).

According to Saunders *et al.*, (2009), the "survey research strategy" involves the structured collection of data from a sizeable population. Not only is the term "survey" frequently employed to characterise the collection of data using questionnaires, but it also refers to other techniques such as "structured observation" and "structured interviews". This type of research is a "popular and common strategy" in business and management research as well. Typically, the survey strategy is connected with the **deductive** approach. It is most regularly employed to answer the questions of "who, what, where, how much, and how many". Consequently, survey research tends to be used for **exploratory** and **descriptive** researches. Surveys allow the collection of a large amount of data from a

sizeable population in a highly economical way. This data is standardised and attained by using a questionnaire administered on a sample.

According to Saunders *et al*. (2009) and Cooper and Schindler (2014), it is possible to conduct the survey strategy as part of the case study research strategies. The research approach that uses both case study and survey research strategies is able to form an accurate and appropriate research design in the research studies as primary research. In cases of marketing research studies, however, there are two different types of research. They are primary and secondary research as described in the next section.

4.8 The Studies of Primary and Secondary Research in Marketing

This part of the research design and methodology express the relationship between **primary** research and **secondary** research in terms of **marketing research**. This is relevant to the research study because this thesis considers marketing as part of the Strategic Marketing Management such as SQ, PV, and SA.

Before explaining the particular characteristics of marketing, research, the definitions of both marketing and marketing research are described by the American Marketing Association (AMA, 2015):

Marketing: Marketing is the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large (Approved in July 2013).

Marketing Research: Marketing research is the function that links consumers, customers, and the public to the market through information – information used to identify and to define marketing opportunities and problems; generate, refine, and evaluate marketing actions; monitor marketing performance; and improve understanding of marketing as a process. Marketing research specifies the information required to address these issues, designs the method for collecting information, manages and implements the data collection process, analyses the results, and communicates the findings and their implications (Approved in October 2004).

This research adopts procedure similar to marketing research as a form of management research (Kent, 1999; and Kolb, 2008). Furthermore, this concept is supported by Kent (1999) and Wilson (2012) explaining that marketing research combines with three major phases: (i) collection, (ii) analysis, and (iii) communication of information. The collection of information or data is done by using a wide range of sources and techniques such as public sources, observing behaviours, interviewing, or surveying (Wilson, 2012). Accordingly, the next phase is the communication and dissemination of information to the relevant audiences.

The data or information is collected through primary and/or secondary research. Each approach differs in terms of strengths and weaknesses to particular research studies. When the two approaches are adopted, the weaknesses or limitations of each approach are likely to be minimised. Hence, both of the approaches have been used for the purposes of this thesis. This approach strengthens both the research reliability and validity as mentioned in the first chapter and the section below.

Primary research can be conducted through observation, qualitative and/or quantitative research. On the other hand, secondary research refers to pieces of information or data which have been gathered for research purposes rather than the current research. This type of research can be collected without the need for fieldwork (Kent, 1999; and Wilson, 2012).

This study contains both primary and secondary research. The primary research, i.e. quantitative, qualitative and mixed method research studies are further described in details in section 4.4 (The Relationship between Qualitative and Quantitative Research Methods). Secondary research refers to literature reviews and relates the relevant articles as already "described and descried", i.e. in Chapter Two (Public-Private Partnership and Satisfaction) and Chapter Three (Transportation Projects in Thailand). These two chapters include and conclude the reviews of literature in the areas of PPP/BOT concepts and projects, strategic marketing management (SQ, PV, SA, and BI), and SD modelling. The quantitative research methods are developed, collected, and analysed in order to evaluate and obtain the SQ elements of EXAT users who perceive value and are satisfied with EXAT projects and its officials. Similarly, the qualitative research approaches are established to accomplish the research questions, aim, and objectives of this thesis. This means that the mixed methods apply to conduct the two significant types of the outlined

research studies, and the process of analysing the qualitative and quantitative data is explained. In conducting primary research to achieve the research aim and objectives, expert interviews were investigated to explore the strategy of the EXAT and its behaviour towards the levels of perceived satisfaction. Lastly, the BTS and EXAT case study research is considered and modelled as the valid model (base model).

4.9 The Reliability and Validity of Content

This has already been mentioned in the first chapter and touched briefly in the preceding section. Research is the work involved in studying something and adding to the body of knowledge on a particular subject. Thus, Jonker and Pennink (2010) suggested that the first and principal step in setting up a piece of research is to define and discover the **research** model as a result of investigation, and how "validity" and "reliability" are achieved in terms of "content".

The key term "research design" can be stated as a grand plan of approach to the research topic. In other words, the research design is the plan for fulfilling research aim and objectives and answering the research questions in this thesis. It is essential to illustrate the research design and to prove it to be reliable and valid prior to organising a particular activity such as a research project (Saunders *et al*., 2009; Jonker and Pennink, 2010; Bryman, 2012; Wilson, 2012; Cooper and Schindler, 2014).

Even though both "reliability" and "validity" will be described in the key term review located in Chapter Six Structural Equation Modelling (SEM) as part of the technique of SEM, it is significant to comprehend them intently as well as to generate a particular methodical approach in cases of SEM and the concept of "content validity" which was already mentioned in the first chapter (Chapter One Introduction) as part of research design and methodology. In order for research data to be of value and of use, they must be both reliable and valid. This means that a hypothesised classification of the categorical variables has been established and developed since both of the key literature review and significant resolution factors have been reached and determined after consideration (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al.*, 2010; Schumacker and Lomax, 2010; and Byrne, 2012).

Reliability

The Oxford Advanced Learner's Dictionary (2016) defines "reliability" as "the quality of being likely to be correct or true". In other words, it may refer to the repeatability of findings. This means, that if the study was to be completely done a second time it would have similar results to the first time. If the data is reliable, this means that it can be trusted to work properly and to behave in the right way. Reliability may also apply to individual measures. For example, if participants undertook a test for the second time in a short period their scores on the two occasions would be very similar. The measure is reliable if measurement of the same phenomena is taken at different times and places should yield the same measurement (Baker, 1999; Saunders *et al.*, 2009; Hair *et al*., 2010).

To be reliable, furthermore, an inventory measuring self-esteem should give the same result such as IQ, intelligence quotient means "a measurement of a person's intelligence that is calculated from the results of special tests" (The Oxford Advanced Learner's Dictionary, 2016). If it was given two times to the same person within a short period of time, IQ tests should not give different results as intelligence is assumed to be a stable characteristic. This means that the research had formed the statistical reliability of the measurements. Then, the test can be publicised as reliable.

It is significant; however, it is not necessary for condition in terms of *validity*. In simpler words, reliability is a necessary yet NOT sufficient condition for *validity* (Bryman, 2012; Cooper and Schindler, 2014; and Creswell, 2014).

Validity

According to the Oxford Advanced Learner's Dictionary (2016), the word "validity" can be defined as "the state of being legally or officially acceptable" and/or "the state of being logical and true". In the beginning, the label "content validity" is one of the four types of validity that are formally recognised in the Standards for Educational and Psychological Tests. These categories were originally identified in 1954 by the American Psychological Association (APA) which classified four types: content validity, construct validity, concurrent validity, and predictive validity (APA, 1954). Each type correlates to different research objectives. Firstly, content validity has to deal with subject-matter content testing. Secondly, construct validity measures abstract theories similar to IQ testing. Thirdly, concurrent validity devises new scales or experiments to replace existing ones. Lastly, predictive validity formulates an indication of future performance. In 1966, the

American Psychological Association (APA) updated the categories of validity to three, combining the last two categories under the term “criterion-related validity”.

In this thesis, only two categories of validity are employed. The former is **content validity** stated previously in this chapter. In addition, the latter is **construct validity** mentioned in Chapter Six, Structure Equation Modelling.

Over the last five decades the concept of validation has derived from establishing correlation with a dependent variable to the concept that researchers must validate each interpretation of each scale, investigation, or instrument measuring a construct as well as in multiple ways which only taken together form the whole of what validity is.

As a consequence, the Standards for Educational and Psychological Tests (APA, 1974) classified the summary which was essentially acceptable for the integrated view of the three types of validity as outlined below:

1. **Content validity**, also called “logical validity”, refers to subject-matter content testing. Surveys of panels of content experts or focus groups of representative subjects are approaches in which the content validity may be established even if applying subjective findings.

2. **Construct validity**, also called “factorial validity”, deals with the logic of items that comprise measures of social concepts. A good construct has a hypothetical basis which is translated through clear operational definitions involving measurable indicators.

3. **Criterion validity**, also called “concurrent validity”, refers to the correlation between scale or instrument measurement items and known and accepted standard measures or criteria.

There are, as previously mentioned, only the two categories of validity being employed in this thesis. The first is content validity stated in this chapter. In addition, the second is construct validity indicated in Chapter Six (Structure Equation Modelling).

Validity may refer to the credibility or believability of the research as well as it may refer to be questioned and answered. Validity could be able to denote the degree to which the indication and concept support the explanations of examination scores achieved by suggested practises of investigations.

For example, are the findings genuine? Is it a valid measure of intelligence? The questions will be answered according to the amount of research support for such a relationship. In other words, it may also be mentioned as the validity of content which is whether it can be trusted or believed. Validity of a measure is, nevertheless, the degree to which the variable measures that it is intended to measure. A valid measure is reliable, yet a reliable measure is not necessarily valid.

According to Cooper and Schindler (2014), there are two aspects of validity:

1. *Internal validity* is the instruments or procedures employed in the research measured what they were supposed to measure.
2. *External validity* concerns whether the results can be generalised beyond the direct study.

The diversity of methods varies according to these two aspects of validity. Experiments, which are structured and controlled, are frequently high on internal validity. Nonetheless, their strength according to structure and control may result in low external validity. The results of the data may be very limited and may prevent generalisation in other situations. In contrast, observational research may have high external validity in terms of generalisation since it has occurred in real life situations. The presence of several uncontrolled variables, however, may lead to low internal validity so that without doubt these variables may affect the observed behaviour (Cooper and Schindler, 2014; and Creswell, 2014).

The relationship between reliability and validity

As previously mentioned, in order to value and use the research data, it must be both reliable *and* valid. This means that a hypothesised classification of the categorical variables must be established and developed once both the literature review and

significant resolution factors have been reached and determined. (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al.*, 2010; Schumacker and Lomax, 2010; and Byrne, 2012).

Reliability can be defined as constancy or consistency in terms of measurement. Reliable procedures are repeatable and replicable. Validity refers to the credibility of the results. This can also be termed "internal validity": the instrument or procedure that measures what it is hypothetical to assess. On the other hand, "external validity" is the result that generalises beyond the immediate study. Research methods vary according to their internal and external validity (Cooper and Schindler, 2014; and Creswell, 2014).

According to Hair *et al.* (2010) and Schumacker and Lomax (2010), if data is valid, it has to be considered reliable. It is a significant but not necessary requirement for *validity*. In other words, reliability is a necessary yet NOT sufficient condition for *validity*. Likewise, a valid measure is reliable, yet a reliable measure is not necessarily valid. For example, if people could obtain different scores on a test every time they took it, the test would be unlikely to predict anything meaningful. This means that the test may be reliable, yet it does not mean that it is valid. Thus reliability is a necessary, but insufficient, condition for validity.

This can be summarised as follows:

The knowledge of scientific and/or engineering issues is one of the ways of perceptions. This is the part of philosophy which deals with knowledge and it is named "epistemology" (The Oxford Advanced Learner's Dictionary, 2016). The scientific and statistic approaches depend on empirical observation.

In order to conclude the relationship of "cause-and-effect", there are three circumstances that must be met:

1. co-occurrence;
2. correct sequence or timing;
3. ruling out other explanations or "third factors/variables".

Validity is broadly recognised as the main criterion in terms of educational and psychological measurement, yet has received less examination than the concept of

reliability; validity has the context of criterion-referenced measurement. Even though the purpose of test length, and questions has been considerably deliberated, not as much attention has been focused on validity rather than reliability (Cooper and Schindler, 2014; and Creswell, 2014).

In general, behavioural science researchers are interested in exploring concepts or constructs. This means that the concepts are abstract generalisations. Theories are the constructs (concepts) that attempt to describe the natural phenomena. They are not directly observable since they are abstract. The theories are examined by generating hypotheses so that they can be confirmed or disconfirmed. In addition, research questions can be outlined as hypotheses even though there is no theoretical issue.

One of the essential contributions of the criterion-referenced analysis experiment has been to highlight content. The clarifications of the measures depend on specific qualifications of the content domain and on the degree to which the measure is representative of the domain. These are the significant mechanisms of content validity.

As a consequence, the content validity of a criterion-referenced measurement may often seem less debatable than that of an examination established by more traditional methods of content specification and item selection. Furthermore, content validity commonly has been held to be the only, or at least the most important, type of validity that is needed for criterion-referenced measures.

In order to ensure both “validity” and “reliability”, this research employs the questionnaire as a research implement, which is essential to examine the content validity and content reliability of the questionnaire. This means that a hypothesised classification of the categorical variables has been established and developed since both of the key literature reviews and significant resolution factors have been reached and determined after consideration (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al.,* 2010; Schumacker and Lomax, 2010; and Byrne, 2012).

The following section describes research strategies to design an effective questionnaire in order to ensure both validity and reliability. The aim of the next section is to develop strategies for dealing with modelling a valid and reliable questionnaire and for determining an appropriate sample size.

4.10 Chapter Summary

As mentioned in the introduction of this thesis, the relevant literature, key publications, academic journals and textbooks were reviewed and analysed in order to establish the need for the study and to ensure good academic and conceptual frameworks. This means that the knowledge of Public-Private Partnership (PPP), Customer Satisfaction (CS), Marketing and Risk Management were explored to generate an idea to achieve the aim and objectives. There is a desire to improve the understanding of user satisfaction with PPP projects in order to improve CS and create a learning laboratory for experimenting with possible options for improving road user satisfaction in BOT projects. Throughout the project System Dynamics (SD) Modelling and Structural Equation Modelling (SEM) were used as simulation tools. In other words, there are still some knowledge gaps between BOT, SD, SEM and CS concepts which need to be completed.

The research study has also demonstrated that a basis exists for both the empirical and conceptual research studies with continuous updating of the body of literature and methodology as a new modelling idea for the future.

The major features of this research study presented in this chapter a description of research design and methodology and other academic activities. These can be carried out on the reinforced knowledge to improve understanding of the research problem statement. Furthermore, this research approach meets the terms of "**Modelling** User Satisfaction with Transportation Public-Private Partnership Projects" as summarised in the title of this thesis as well as attempting to attain the research questions, aim, and objectives.

The next chapter of this research study continues to express the body of knowledge in terms of constructing a conceptual model. This is links User Satisfaction (US) and Transportation PPP Projects.

CHAPTER FIVE
CONSTRUCTING A CONCEPTUAL MODEL

5.1 Introduction

The preceding chapter explored the research design and methodology which aimed to answer the research questions (1.4) and statement of the research problem (1.3) addressed in the introduction in chapter one. The research methodology has been selected as the most suitable to address the questions.

In this chapter, it continues to provide further concept of constructing a concept model. The concept model is the way to deliver a visual representation of hypothetical constructs and variables of SEM. In addition, the research study has established that a basis exists for both the empirical and conceptual research studies with continuous updating of the body of literature and methodology as a new modelling idea for the future.

The research methodology has also been chosen as the most suitable to address the questions. As previously stated, it is imperative to realise both reliability and validity of content in order to develop the approach in cases of SEM and the concept of content validity. Not only does the research design and methodology take into account the need for ensuring that the data is implemented accurately, but this research study is current to express the body of knowledge in terms of constructing a conceptual model. This research study, particularly this chapter, connects the theory between User Satisfaction (US) and Transportation PPP Projects. Furthermore, it is formulated to construct a conceptual model visually.

5.2 Constructing a Model to Determine the Extent of Perceived Satisfaction

The previous chapter discussed validity and reliability in relation to content. This chapter, mainly this section, explains the research strategies and sample methods, including discussion of the sampling technique adopted, to distribute copies of the questionnaire after constructing the model. Each question in the questionnaire is designed for the survey (quantitative) and for the interview (qualitative) in order to conduct the case study

research. The data collection of the questionnaire will generate the raw data necessary for analysing levels of perceived satisfaction.

The intended benefits from EXAT facilities were the benchmark for making comparisons of the perceived satisfaction of the users. Evaluation of the project was completed on the criteria and/or policies with the view to the benefits in accomplishing stakeholder satisfaction with understanding of PPP projects. That means the appropriate choice of the research strategies can be directed by the research questions with the aim and objectives (Creswell, 2009; Saunders *et al.*, 2009; Jonker and Pennink, 2010; Cooper and Schindler, 2014; and Creswell, 2014).

5.3 Modelling the Levels of Satisfaction between the Users and Officials

According to the case study research on BTS User Satisfaction (US), a model in this research study can be seen in Figure 5.1 Modelling Levels of the Satisfaction between the Users and Officials. The overlapping area from the two circles indicates the term "satisfaction" between EXAT services and the needs of stakeholders essentially focused on the EXAT users and officials. EXAT is the service provider and policy maker.

Similarly, each relevant stakeholder in the EXAT system also possesses a certain set of expectations. If a service provided by EXAT to the individual is well accepted, it is likely that the recipient will be satisfied with EXAT services on different aspects. The levels of satisfaction would relate to the extent of achievement of the perceived benefits. The extent of the satisfaction levels concerns both physical and psychological aspects that can be measured through a questionnaire.

Figure 5.1 demonstrates each physical and psychological condition by the area of intersection between EXAT Services and the perceived satisfaction of the users and officials.

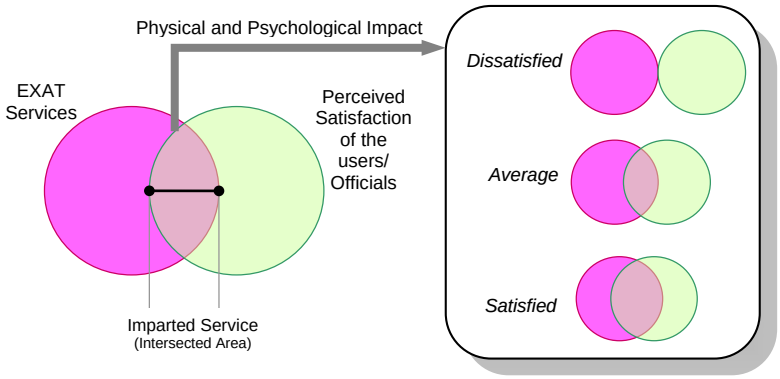


Figure 5.1: Modelling the Levels of Satisfaction between the Users and Officials

Adapted from Figure 3.1: Model to Represent Levels of Satisfaction

After modelling the levels of satisfaction between the Users and Officials, a Structural Equation Modelling Research Framework is then constructed. In order to build an effective model, this study reviews key research articles on the subject of modelling. This includes a summary of academic journal articles relevant to the research topic covering areas such as project management, construction management, risk management and customer satisfaction and Structural Equation Modelling (SEM).

Before focusing on the construction of a statistically conceptualised model, it is necessary to develop theory-based hypotheses in order to link the latent variables to each other and to their corresponding indicators (Hair *et al*., 2010; Schumacker and Lomax, 2010; and Sreejesh and Mohapatra, 2014). The hypotheses is o formulated to study of the conceptual framework of the research model.

5.4 Study of the Conceptual Framework of the Research Model

This part is expressed by introducing SEM and its approach to modelling variables in the SEM research framework. SEM stands for Structural Equation Modelling. It is one of the advanced statistics which is part of the statistical method series. It has become popular among the social sciences research methods for years.

According to Cuttance and Ecob (1987), Byrne (1998), Maruyama (1998), Byrne (2001), Schumacker and Lomax (2004), Byrne, 2010, Hair *et al*. (2010), Schumacker and Lomax (2010), (Byrne, 2012) and Cooper and Schindler (2014), not only is SEM designed to

examine a conceptual, theoretical or hypothetical model, it is also the well balanced combination between methodological and statistical development in the social and behavioural sciences. This means that the advanced numerical method allows the evaluation of both the direct and indirect relationships among all of the latent variables (factors). In addition, this high level of statistical technique allows complex relationships between one or more observed variables (Indicators) and one or more latent variables.

In other words, the statistics will be enhanced by modelling the structural equations of the two groups of variables between a **measurement model,** referring to the latent variables (factors) employing one or more observed variables (Indicators), and a **structural model** linking all the latent variables together.

This consists of SEM modelling, including Confirmatory Factor Analysis (CFA), path analysis, and latent growth modelling. It can also be concluded that Structural equation modelling (SEM) employed analysis of covariance structures to explain causality among constructs (Cuttance and Ecob, 1987; Byrne, 1998; Maruyama, 1998; Byrne, 2001; Schumacker and Lomax, 2004; Byrne, 2010; Hair *et al*., 2010; Schumacker and Lomax, 2010; Byrne, 2012; and Cooper and Schindler, 2014).

Not only is SEM used in cases of social and behavioural sciences, it is often elaborated in order to be used with one of the commercially available, modelling specific, software packages such as LISREL, AMOS and Mplus (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al*., 2010; Schumacker and Lomax, 2010; and Byrne, 2012). The LISREL programme, nevertheless, was the first SEM software package (Kelderman, 1987; Cuttance and Ecob, 1987; Byrne, 1998; Hair *et al*., 2010; and Schumacker and Lomax, 2010).

Other SEM software programmes including AMOS and Mplus have become available since the mid-1980s. Each SEM analysis software has its own unique techniques offering particular features for conducting different SEM analysis programmes.

For example, according to Cuttance and Ecob (1987), some of these SEM software packages provide:

1. statistical analyses of raw data, e.g. means, correlations, and missing data conventions;

2. routines for handling missing data and detecting outliers;
3. the programme's syntax, e.g. drawing the model;
4. for importing and exporting data and figures of a hypothetical model.

Using both primary and secondary research, this study includes the relevant subjects to conceptualise an effective model. These can also be included and concluded that Service Quality (SQ) is an **antecedent** of Customer Satisfaction (CS). This is because the User Satisfaction (US) exerts a strong influence on what is perceived as quality of service.

In the context of the EXAT facility including services, the standard of quality of services provided by vendors can be measured by how satisfied users of the services are with the quality of service. There is an amount of interest among researchers in the literature in cases of the use of structural equation modelling (SEM) technique to examine causal relationships between Service Quality and User Satisfaction. This is developed and tested through the quantitative study in order to achieve a reliable and valid model. The SEM model examines the influence of SQ antecedents on US. (Oliver and DeSarbo, 1988; Oliver, 1999; Parasuraman and Grewal, 2000; Gallarza and Gil, 2006).

This is an innovative technique in conducting research studies by providing a mechanism for modelling the relationship between "Service Quality" and "Satisfaction", transferring the academic knowledge from marketing, Customer Satisfaction (CS) to engineering, Road User Satisfaction (US).

This means that the constructs of Perceived Value (PV), Service Quality (SQ) and Satisfaction (SA) have been discussed and modelled. Not only are the modelled constructs as SQ, PV and SA, but the concluding model also consists of Behavioural Intentions. Even though the Behavioural Intentions (BI) have been discussed in depth in marketing literature, few studies have been undertaken in relation to transport and construction engineering management (Parasuraman *et al.,* 1985; Parasuraman *et al.,* 1988; Oliver, 1993; 1999; Wen *et al.,* 2005; Joewono and Kubota, 2007; Oliver, 2010; and Sumaedi *et al.,* 2012).

5.5 Study of the Construction of a Conceptual Model

As expressed earlier, in this chapter, it continues to study and provide the further concept of constructing a conceptual model. The conceptual model is the way to deliver a visual representation of hypothetical constructs and variables of SEM. According to the review of significant literature, the research study has to be strengthened in the areas of SA/CS/US and connected to Public-Private Partnership (PPP) projects and/or transportation. In order to fulfil the research questions, aim, and objective, one must acquire knowledge of instances of marketing (CS) and engineering (US) concepts which link and model both SD and SEM stimulation techniques in PPP transport projects. In other words, there are still knowledge gaps between PPP, SD, SEM, and CS/US concepts which need to be bridged. Furthermore, these are part of the research study to fulfil the terms of "Modelling User Satisfaction with Transportation Public-Private Partnership Projects" as it is the title of this thesis as well as to attempt to achieve the research questions, aim, and objectives.

Nine academic journal articles are relevant to this research study as expressed in Section 3.9. Each of them focused on CS/US in terms of PPP and/or transportation projects. It depicted the relevant literature which informed the critical understanding of the topic. Furthermore, the literature review needed to be strengthened in the areas of Customer/User Satisfaction (CS/US) studies on PPP and/or transportation projects. Empirically, preceding research studies have confirmed a direct positive relationship between Customer/User Satisfaction (CS/US) and Behavioural Intentions (BI) in numerous industries including public land transport services (Parasuraman *et al.,* 1985; Parasuraman *et al.,* 1988; Oliver, 1981; 1993; 1999; Wen *et al.,* 2005; Joewono and Kubota, 2007; Chou and Kim, 2009; Oliver, 2010; Lai and Chen, 2011; Wu *et al.,* 2011; Sumaedi *et al.,* 2012; and Kuo and Tang, 2013).

These are listed in Table 5.1: Modelling Variables in the SEM Research Framework. Five of these articles claim that BI is a significant regulating variable which meaningfully impacts on "customer loyalty" through such Service Quality (SQ) factors as Perceived Value (PV) and Customer Satisfaction (CS). After measuring and modelling the levels of the perceived satisfaction of EXAT users and officials, the results relate to expectation criteria especially focusing on the users who perceive the EXAT facilities as SQ, PV, SA,

and BI. Correspondingly, the qualitative approaches have also been employed as part of research designs to qualify a verified and validated model as a valid model (base model).

In other words, the constructs of Perceived Value (PV), Service Quality (SQ) and Satisfaction (SA) have been discussed and modelled. Not only are the constructs as SQ, PV and SA modelled, but the concluding model also comprise Behavioural Intentions (BI). Then, a generated idea linking between the Public-Private Partnership (PPP) concepts, Customer Satisfaction (CS) approaches, and both of System Dynamics (SD) and Structural Equation Modelling (SEM) theories is established. This conceptual model is developed for the US of the EXAT as the PPP expressway projects

Table 5.1: Modelling Variables in the SEM Research Framework

Factors	The reviews of the academic journal articles								
	1. Kuo and Tang (2013)	2. Chen (2008)	3. Lai and Chen (2011)	4. Sumaedi *et al.* (2012)	5. Chou and Kim (2009)	6. Wu *et al.* (2011)	7.Joewono and Kubota (2007)	8. Saha and Theingi (2009)	9.Eboli and Mazzulla (2012)
Antecedents of Satisfaction	Service Quality	-Expectation - perceived performance	Service Quality	Service Quality	- Technical quality - Functional quality	Service Quality	Service Quality	- Tangible features - Schedules - Services provided by ground staff - Services provided by flight attendants	Service Quality - Safety - Cleanliness - Comfort - Service - Additional Services - Information - Personnel
	Corporate Image	Perceived value	Perceived value	Perceived value	Corporate Image	Perceived value	Financial		
				Perceived sacrifice		Corporate Image			
Customer Satisfaction	Satisfaction	Satisfaction	Satisfaction	Satisfaction	Satisfaction	Satisfaction	Satisfaction	Satisfaction	Satisfaction/ Important
Consequences of Satisfaction	Behavioural Intentions	Behavioural Intentions	Behavioural Intentions	Behavioural Intentions	Loyalty	Behavioural Intentions	Loyalty	repurchase intention	
			Involvement		Complaint			Word-of-mouth	
								Feedback	

After measuring and modelling the levels of perceived satisfaction of EXAT users and officials, the results relate to expectation criteria especially focusing on the users who perceive the EXAT facilities as SQ, PV, SA, and BI. Correspondingly, the qualitative approaches have also been employed as part of research designs to qualify a verified and validated model as a valid model (base model).

Even though the nine research articles studied on PPP and/or transportation projects, they have not yet covered road users (particular in Thailand). Only rail and air transportation projects have been researched. That is why the revised model is essential as the conceptual model. Then, the model can identify and evaluate the benefits associated with the EXAT projects. Hence, this research study includes the content and model validity of relevant experts. These can be found and formed as a relationship of the Satisfaction (SA) Factor between "Antecedents of SA" and "Consequences of SA" (Oliver and DeSarbo, 1988; Oliver, 1999; Parasuraman and Grewal, 2000; Gallarza and Gil, 2006).

5.6 SEM Research Framework and Hypotheses

In this thesis, there is a generated SEM framework (Figure 5.2) which has been researched, built, and modelled on reviews of reliable and valid SEM articles mainly focused on nine academic journal articles which are relevant to this research study as shown in Table 5.1: Modelling Variables in the SEM research framework. The data collection is conducted by the questionnaire as the statistical research tool and analysed by the statistical method package, i.e. the Linear Structural RELationships (LISREL) programme.

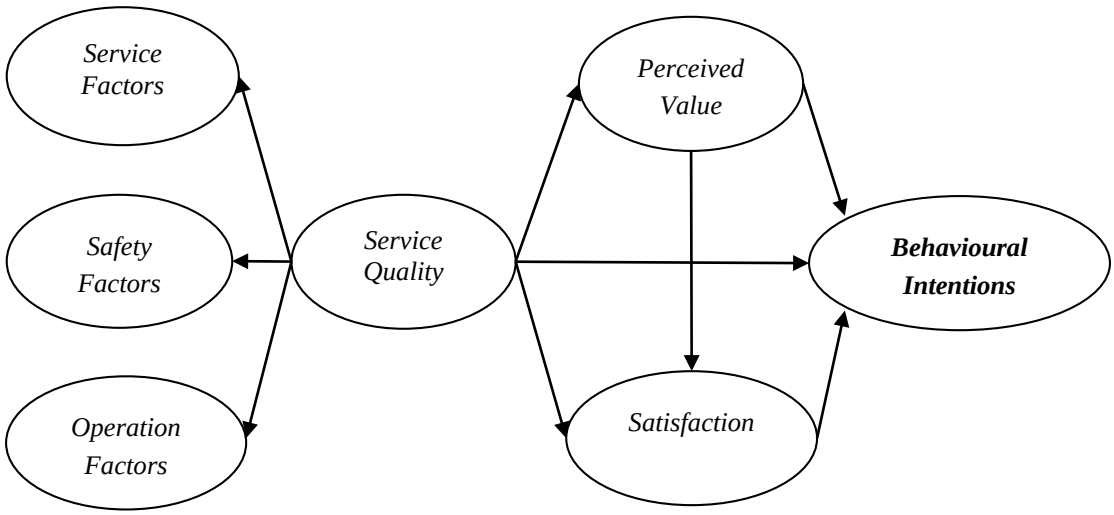


Figure 5.2: Proposed hypothetical model of Perceived Satisfaction of EXAT Users

Adapted from the reviews of the academic journal articles and Figure 3.4: Causes Tree

These theoretical constructs are also composed between "Observed Variables (Indicators)" and "Latent Variables (Factors)". This means that a proposed hypothetical model consists of Service Quality (SQ), Perceived Value (PV), Satisfaction (SA), and Behavioural Intentions (BI) as well as path analyses associated with the variables. A finalised model is depicted in Figure 5.2: Proposed hypothetical model of Perceived Satisfaction of EXAT Users. Table 5.2 lists the summary of a proposal of SEM hypotheses.

Table 5.2: Summary of a Proposal of SEM Hypotheses

Hypothesis (H)	Path Analysis
H1	Service Quality (SQ) → Perceived Value (PV)
H2	Service Quality (SQ) → Satisfaction (SA)
H3	Service Quality (SQ) → Behaviour Intentions (BI)
H4	Perceived Value (PV) → Satisfaction (SA)
H5	Perceived Value (PV) → Behaviour Intentions (BI)
H6	Satisfaction (SA) → Behaviour Intentions (BI)

Design an EXAT questionnaire

First of all, in order to view both "validity" and "reliability", this research employs the questionnaire as a research implement, which is essential to examine the content validity and content reliability of the questionnaire. In order to value and use the research data, furthermore, they must be both reliable and valid. This means that a hypothesised classification of the categorical variables has been established and developed since both of the key literature reviews and significant resolution factors have been reached and determined after consideration. Additionally, the model can be valid and tested through quantitative study (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al.*, 2010; Schumacker and Lomax, 2010; and Byrne, 2012).

This study uses a questionnaire as the research tool for the collection of data. According to relevant academic articles on research design and methodology, particularly Tangkitsiri and Ogunlana (2004) and Tangkitsiri *et al.* (2013a), these can also be

organised and designed to create an effective questionnaire that ensures reliability and validity of content.

In the questionnaire used for this study age range is sorted into four levels according to those used in the Thai Motor Act in cases of automobile insurance in Thailand (OIC, 2015).

The Likert Scale is used for participant responses. The questions in the questionnaire are measured by scale-reading the questions. These questions are established and relevant to the research questions, aim, objectives, and the directions of BTSC and EXAT marketing strategies. When designing a model and a questionnaire, this research is also constructed on marketing theories including "Service Quality (SQ) and Satisfaction (SA) Factors for EXAT Users and Officials". All of the SQ Factors of the EXAT Questionnaire are associated with the five principal dimensions. These are depicted in Table 5.3: Links between Service Quality (SQ) Factors and Scale Dimensions adapted from Parasuraman *et al.* (1988), Zeithaml *et al.* (1990).

Next, according to Armitage and Conner (2001), BI is "**Behaviour**-Specific and operationalised by direct questions with **Likert Scale** response choices to measure relative strength of intention. Correspondingly, in cases of "Perceived Satisfaction", the format of this research questionnaire is designed as a five-point Likert scale ranging from "High Level of Satisfaction (5) to Low Level of Satisfaction (1)" to ease of rating (Likert, 1932; Tangkitsiri and Ogunlana, 2004; Armitage and Conner, 2001; and Norman, 2010).

The last and most important aspect for consideration in the design and implementation of the questionnaire concerned ethical considerations. As the first step and in agreement with the Heriot-Watt University (HWU) requirements, all projects or fieldwork involving human issues must have approval from the university's research ethics committee before fieldwork can be undertaken. Consequently, the H-W U research ethics application and risk assessment forms were filled in and signed by the H-W U researchers and the main supervisors before submitting to the post graduate ethics review committee for ethical approval to conduct the fieldwork. Permission was granted.

In compliance with the HWU policies, this questionnaire itself conveys the purpose of the research study. The names of the researchers, supervisors and participants, are not

provided, indeed assurances of absolute anonymity and confidentiality have been made. The personal information of participants was not included in any of the study findings whilst data collected was not used for any purpose other than as stated in the study objectives of fulfilling the requirements for a PhD thesis. These are stated in an addendum at the very end of the questionnaire as depicted below:

This survey is used for PhD research by Worapong Tangkitsiri (wt89@hw.ac.uk; +447594554459), School of the Built Environment, Heriot-Watt University. Supervised by Prof Stephen Ogunlana & Dr Adekunle Oyegoke. It aims to improve the understanding of stakeholder satisfaction with a view to improve user satisfaction. This research has been approved by the relevant Ethics Committee and it is completely anonymous and confidential.

The one-page questionnaire is shown in Appendix C: The Questionnaire Forms in Thai and English. All of the SQ Factors of the EXAT Questionnaire are associated with the five principal dimensions (Parasuraman *et al*., 1988; and Zeithaml *et al*., 1990) and Service Quality (SQ) Scale Dimensions for Customers/Users. These are itemised in Table 5.3.

This research study implements statistical analyses to describe the attitudes and behaviours of participants without bias. In forms of verbal communication, this employs statistical strategies to code or name each question in the questionnaire in order to ease the naming and wording process. In simpler terms, when naming the words, phrases, or sentences by a technical acronym, it is much easier to follow. This not only helps with analysing the quantitative data, but this is also essential to save time and space, as well as improving the accuracy of the findings. Table 5.4 contains the Code or Name for Each Question in the Questionnaire.

Table 5.3: Links between Service Quality (SQ) Factors and Scale Dimensions

The 5 Principal Dimensions	The SQ Factors of EXAT Questionnaire
1. Tangibles: Appearance of physical facilities	
	▪ The convenience of using the expressway ▪ The sufficiency of traffic signs to display traffic signals ▪ The clarity of traffic signs to display traffic signals ▪ The safety of junctions on expressways ▪ The safety of expressway ramps connecting to non-express roads ▪ Sufficient networking of expressways
2. Reliability: Ability to provide service dependably and accurately	
	▪ The safety of junctions on expressways ▪ The safety of expressway ramps connecting to non-express roads ▪ Efficiency of toll collection systems (including Easy Pass) ▪ The predictability of travel time ▪ Confidence in using the expressway due to free accident services
3. Responsiveness: Willingness to assist and deliver prompt service	
	▪ Quickness in passing through the pay station(s) (including Easy Pass) ▪ Short travel time on expressways relative to other routes ▪ Appropriate Fare ▪ Good feeling using the expressway because emergency phones are installed at every 1 km on the expressway ▪ Confidence in using the expressway due to free accident services
4. Assurance: Knowledge base and courtesy of members of staff	
	▪ Efficiency of toll collection systems (including Easy Pass) ▪ Traffic management ▪ The cleanliness of expressways ▪ Information regarding traffic conditions & significant events through variable message signs (VMS) is beneficial
5. Empathy: Caring attention to the customers/users provided by the service organisation	
	▪ Good feeling using the expressway because emergency phones are installed at every 1 km on the expressway ▪ Confidence in using the expressway due to free accident services ▪ Confidence due to closed-circuit television (CCTV) monitoring traffic conditions and incidents on the expressway ▪ Feeling of safety whilst driving on the expressways

Adapted from Parasuraman et al. (1988), Zeithaml et al. (1990), and the Table 2.1: Service Quality (SQ) Scale Dimensions for Customers/Users

Table 5.4: Code or Name for Each Question in the Questionnaire

Measured Variables in each Factor	Code/ Name
Service Quality	**SQ**
1. Service Factors	**SQ1**
The convenience of using the expressway	SQ1_1
Quickness in passing through the pay station(s) (including Easy Pass)	SQ1_2
Short travel time on expressways relative to other routes	SQ1_3
Appropriate Fare	SQ1_4
Good feeling using expressways because emergency phones are installed at every 1 KM on expressways	SQ1_5
Confidence in using the expressway due to free accident services	SQ1_6
2. Safety Factors	**SQ2**
Confidence due to CCTV monitoring traffic conditions and incidents on the expressway	SQ2_1
The sufficiency of traffic signs to display traffic signals	SQ2_2
The clarity of traffic signs to display traffic signals	SQ2_3
The safety of junctions on expressways	SQ2_4
The safety of expressway ramps connecting to non-express roads	SQ2_5
Feeling of safety whilst driving on the expressways	SQ2_6
3. Operation Factors	**SQ3**
Sufficient networking of expressways	SQ3_1
Efficiency of toll collection systems (including Easy Pass)	SQ3_2
Traffic management	SQ3_3
The cleanliness of expressways	SQ3_4
The predictability of travel time	SQ3_5
Information regarding traffic conditions & significant events through VMS is beneficial	SQ3_6
Perceived Value	**PV**
Value for money	PV1
Saving travel time	PV2
Improving the quality of the traveller's life	PV3
Satisfaction	SA
Overall Satisfaction with Service Factors	SA1
Overall Satisfaction with Safety Factors	SA2
Overall Satisfaction with Operation Factors	SA3
Overall Satisfaction with expressways	SA4
Behaviour Intentions	BI
Willingness to use the expressways frequently	BI1
Willingness to recommend the EXAT (facilities) to other people	BI2
Willingness to travel despite fare increases	BI3

Adapted from the "Level of Satisfaction with the EXAT services" Questionnaire

After completing the design of the questionnaire, a pre-test study was conducted in Edinburgh, Scotland through a series of semi-structured interviews which shaped the verification and validation of both the preliminary and concluding findings. Then, a pilot test for this thesis research was conducted on the targeted users, i.e. EXAT road users to gain a pre-understanding of the phenomena under investigation. This is a quality control measure that gives feedback to further improve the questionnaire and ensure that replies to the survey are reliable and provide sound data for analysis. This pilot survey was carried out in April/May 2014.

5.7 Research Strategies and Sampling Methods

As previously quoted in Research Philosophy and Design (4.2) and Research Approach (4.3), Creswell (***2009***) mentioned that research ***designs*** are plans and the procedures for research. Informing this decision should be the ***worldview*** assumptions the researcher brings to the study; procedures of inquiry (called ***strategies***); and specific ***methods*** of data collection, analysis, and interpretation. Creswell **(2014)** argued that research **approaches** are the plans and procedures for research. Informing this decision should be the **philosophical** assumptions the researcher brings to the study; procedures of inquiry (called **research designs**); and specific **research methods** of data collection, analysis, and interpretation.

The available evidence clearly leads to the conclusion found by Creswell (***2009***; and **2014**) that the plans and the procedures for research are either the research ***designs*** or **approaches. T**he ***worldview*** assumptions mean the **philosophical** assumptions. The procedures of inquiry can also be called ***strategies*** or **research designs,** and the specific ***methods*** refer to the specific **research methods.** These are also presented in Figure 4.2: A Framework for Research Designs and Figure 4.5: A Cross Section of Philosophical Worldviews in Research. Saunders *et al*., (2009) commented that research strategies are assessed and considered as part of "Philosophical Worldviews" in Research. Consequently, there are seven categories of research strategies in terms of management research studies. These are: (i) experiment; (ii) survey; (iii) case study; (iv) action research; (v) grounded theory; (vi) ethnography; and (vii) archival research. Additionally, there are philosophical world views as demonstrated in Figure 4.5 "A Cross Section of Philosophical Worldviews in Research" which is adapted from Creswell (2003; 2009; and 2014), Robson (2011), and Saunders *et al.* (2009).

From the categories of the research strategies, this research study implements case study and survey research led by the research questions, aim, and objectives. This is expressed in the two following sections, i.e. 4.6 Case Study Research and 4.7 Survey Research consecutively.

According to the research questions and strategies, sampling methods concentrate on observational methods, questionnaire survey sampling, interview questions, and data and model reviews. These are also publicised as "data collection and analysis" and "model verification and validation (V&V)" in Figure 4.2 as part of the framework for research designs and Figure 4.5 as part of research method.

5.8 The Strategy of Sampling

In order to explain and justify the sampling strategy for the questionnaire survey, according to Hair *et al*. (2010), it is quoted that as SEM develops, and further research is undertaken on key research design issues, previous guidelines such as "always maximise the sample size" and **"sample sizes of *300* are required"** are no longer suitably appropriate. It is still correct that larger samples commonly generate more stable solutions that are more likely to be replicable.

Furthermore, it has been publicised that the decision on the sample size should be decided by researchers on where to locate a set of constructed factors. The following suggestions for minimum sample sizes are offered based on the model complexity and basic measurement model characteristics:

(i) Minimum sample size-100: Models containing five or fewer constructs, each with more than three items (observed variables)

(ii) Minimum sample size-150: Models with seven constructs or less, modest communalities

(iii) Minimum sample size-300: Models with seven or fewer constructs, lower communalities, and/or multiple under-identified (fewer than three) constructs.

(iv) Minimum sample size-500: Models with large numbers of constructs, some with lower communalities, and/or having fewer than three measured items.

For this research project, number (iv) above was chosen. In addition to these characteristics of the model being estimated, the number of the sample size in this research study was **561** (EXAT users) due to the number of the effective respondents from EXAT users and the limitations of the research study (Wu *et al.*, 2011; and Kuo and Tang, 2013)

Initially, six hundred copies of the EXAT satisfaction questionnaire were launched on site. In the case of the EXAT officials, the number of the sample size was 52, fulfilling the minimum 10% suggested by Baker (1999).

5.9 Data Collection

This section describes the techniques used for data collection, sample methods, and the design technique. It also describes the method used to distribute the questionnaire and the decisions involved in determining the sample size.

Pilot Study

The word pilot study can be defined as "done on a small scale in order to see if something is successful enough to do on a large scale" (The Oxford Advanced Learner's Dictionary, 2016). This means that a pilot study is an important technique in exploratory or preliminary stages of the questionnaire development. The **tryout/trial** involves testing how effective it is before deciding whether to use it in the future as a small scale primary investigation (Cooper and Schindler, 2014; Creswell, 2014; The Oxford Advanced Learner's Dictionary, 2016).

A pilot study/project can be employed as a small scale version or study carried out to test the applicability of the constructs of a questionnaire or interview. A pilot study is a preliminary investigation conducted in order to organise a trial run in preparation for a major experiment (Baker, 1999; Saunders *et al.*, 2009; Hair *et al.*, 2010; Bryman, 2012; Cooper and Schindler, 2014; and Creswell, 2014).

Both Yin (2011) and Creswell (2014) noted that instrument construction is an example of this technique. A draft of a research tool, i.e. survey, experiment or investigation is piloted with a small number of cases that frequently supply a significant qualitative view in terms of linking experience and the research instrument. Review of the results means

that adaptations to the research implement can be made in order by using to collect further quantitative data. The strengths and weaknesses of this technique are similar to those of the mixed-methods sequential explanatory study.

Even though it is a small-scale preliminary and exploratory investigation, it is must be conducted in order to evaluate feasibility, time, cost, quality, and the effect if the sample size in terms of the statistical variability. It is also used to predict an appropriate sample size and improve upon the study design prior to launching of a full-scale research project (Yin, 2011). A further benefit to conducting a pilot study is to that it helps to iron out issues of comprehension on the part of respondents. Furthermore, the pilot investigation highlights issues that permit the assessment of each question in the collected survey questionnaire. This strengthens the reliability and viability of the data (Saunders *et al.*, 2009; and Yin, 2011).

Preliminary analysis data supplies the pilot test data and should be carried out to 'reality check; the collected data so that one the questionnaire is launched it will enable the investigative questions to be answered fully and in a way that is meaningful (Saunders *et al.*, 2009; Bryman, 2012; Cooper and Schindler, 2014; and Creswell, 2014).

The pilot test for this thesis research was conducted on the targeted users, i.e. EXAT road users to gain a pre-understanding of the phenomena under investigation. This is a quality control measure that provided feedback to ensure that the questionnaire for the main survey would produce reliable data. The outcome of the pilot was used in the development of the final questionnaire. This pilot survey was carried out in April/May 2014

In January 2014, reviews were undertaken with academic experts and cognitive interviews called "Index of Item-Objective Congruence or Item-Objective Congruence Index (IOC) where undertaken. In order to ensure content validity, the questionnaire was reviewed by experts who rated items of the content in relation to how well they would achieve the aim and/or objectives of the designed questionnaire. In other words, "content validity" was established as "logical validity", i.e. the degree to which the content of the objects reflects on the content domain of logical interest, to ensure the result can be legally and officially acceptable (Saunders *et al.*, 2009; Bryman, 2012; Cooper and Schindler, 2014; and Creswell, 2014).

A pilot study should allow a researcher to assess content validity using the index of item-objective congruence (IOC) measurement (Rovinelli and Hambleton, 1977; and Turner, R.C., and Carlson, L. 2002). In other words, before implementing the pilot test, the confirmation of content validity would be able to be attained from an assessment which conducted on and corrected by at least three independent experts. The independent assessment of the experts would test, the effectiveness of questionnaire sections in measuring one or more objectives. Berk (1984) identified that an assessment of the congruence between items and objectives is the most essential evaluation during the content validation phase. If there was insufficient evidence to demonstrate that the items were measuring what they were intended to measure, these remaining analyses would be useless. An effective measure for numerically evaluating the content of the experts' assessments of these items is the IOC (Rovinelli and Hambleton, 1977). These ratings from content experts are acquired in order to assess the match between test items and the table of specifications (Berk, 1984).

Even though the pilot study is one of the most critical aspects of a successful survey, the pilot study is also essential in determining and examining the survey questionnaire before launching it to collect data. Pre-testing and piloting can be implemented to identify questions to ease the participants' comprehension of each question in the questionnaire clearly and without bias. Before launching the EXAT users' satisfaction questionnaire as the pilot test, the pre-test has taken on the meaning of testing within a survey laboratory rather than in the survey field with the targeted population. This means that, in this research timeline, the pre-test was distributed among students in Edinburgh, Scotland, UK in February 2014. Then, any changes resulting from the EXAT questionnaire were considered and altered accordingly and completed in March 2014.

It is concluded that "a **pilot test**" is regularly called a "**trial** or **tryout**" as a research implement. Moreover, it is stated that a pilot test conducting a sample size of 10 per cent of the actual study sample size is a reasonable number of participants to enlist (Baker, 1999). Furthermore, Yin (2011) pointed out that the aim of a pilot project is to assist, to determine, to examine, and to refine one or more features of a final exploratory test. For example, its design, fieldwork procedures, data collection instruments, or analysis strategies can be investigated. At this point, the number of the EXAT users is 60 in this

pilot experiment. The pilot study will be able to provide another opportunity to validate the SEM model.

Summary of Sample Size

As quoted earlier, it is stated that as SEM develops, and further research is undertaken on key research design issues, previous guidelines such as "always maximise the sample size" and "sample sizes of 300 are required" are no longer suitably appropriate. It is still correct that larger samples commonly generate more stable solutions that are more likely to be replicable (Hair *et al*., 2010).

For this research project, number (iv) above was chosen. In addition to these characteristics of the model being estimated, the number of the sample size in this research study was **561** (EXAT users) due to the number of the effective respondents from EXAT users and the limitations of the research study (Wu *et al.*, 2011; and Kuo and Tang, 2013)

5.10 Data Analysis

As formerly discussed in the introduction, the literature review informed the research design and methodology in and directly contributed to the reliability and validity of the research. The use of quantitative, qualitative, and mixed methods were also essential, as shown in to Figure 4.2: A Framework for Research Designs and Figure 4.5: A Cross Section of Philosophical Worldviews in Research. The mixed methods were implemented to fulfil the research questions, aim, and objective in this study as well as to verify and validate an analysed model. This means that the quantitative research provided numerical outcomes with modelling diagrams whilst the qualitative research were found and formed by expert interviews and reviews achieving the "Model Verification and Validation (V&V).

In order to analyse the quantitative data the researchers were first of all able to implement statistical analysis to describe the attitudes and behaviours of participants without bias. The analysis initiates a pre-analysis phase where the data is reviewed including examining its reliability (Cronbach's Alpha) as well as coding answers of "Open-Ended and Close-Ended Questions. Next, the frequency of response, Mean (M), and Standard Deviation

(SD), were calculated. Lastly, statistical data was tested by the cross analysis in order to determine error or the difference of statistical techniques.

In order to consider analyses of the qualitative and quantitative research approaches, the data was transcribed from verbal information and then coded. The coding was completed by theme and name (and listed in Table 5.4: Code or Name for Each Question in the Questionnaire) and by looking for insight information used for answering research questions, aims, and objectives. These concepts were analysed in relation to the research aims and objectives. Finally, information was interpreted in order to provide recommendations for action such as the Model Verification and Validation (V&V).

In this research study, the response to questions were analysed by various statistical methods including Analysis Of Variance (ANOVA), Levene's Test, Kruskal-Wallis Test, and Mann-Whitney U Test. The tests were also considered by the cross analysis research strategy. This meant that the analyses of descriptive statistics such as Mean and Standard Deviation (SD) were selected to support the research questions, aim, and objectives. These were also significant and relative to the perceived satisfaction of the EXAT users and officials. As a consequence, Levene's Test, ANOVA, and Mann-Whitney U Test were employed to model the perceived satisfaction levels between the users and officials in several characteristic aspects. Kruskal-Wallis Chi-square (χ^2) test was also required to determine the relationship between characteristics of the EXAT respondents and the SQ, SA, PV, and BI factors (service, safety, operation, and other factors in the form of the survey questionnaire).

The study of influential personal information details in the questionnaire survey form, e.g. gender, age, and frequency, Kruskal-Wallis Test is also performed. For statistical analysis, the collected data was implemented and analysed by statistical software packages, i.e. Microsoft Excel and Statistical Package for the Social Sciences (SPSS). A comparison between the outcomes of the research and the proposed aim and objectives has been achieved.

SEM was also generated on EXAT users in order to develop a model for assessing the satisfaction of stakeholders. After modelling and analysing the research model by the SEM programme, LInear Structural RELationships (LISREL) already has an accurate model. In order to acquire a valid/base model, however, the model should be legally or

officially acceptable in line with EXAT policy. Not only does the analysed and proven model state officially that it is beneficial and of an adequate standard, but this SEM model has also attained validity (Cuttance and Ecob, 1987; Kent, 1999; Kotler and Keller, 2006; Kent, 2007; Kolb, 2008; Saunders *et al.*, 2009; Hair *et al*., 2010; Schumacker and Lomax, 2010; Wilson, 2012; Cooper and Schindler; 2014; Creswell, 2014).

A comparison between the outcomes of the research and the proposed aim and objectives has been achieved. This means that research findings from this case study interview are developed and expected to accomplish a valid (base) model. A more in-depth analysis of the data gathered and results obtained from the study are illustrated in Chapter Five Questionnaire Survey Analysis and Chapter Six Structural Equation Modelling.

Examination of Reliability

After affirming the uni-dimensionality and convergent validity, reliability of the scale was examined. Generally, reliability, i.e. Cronbach's alpha, is an implemented assessment of internal reliability. It is crucial to determine the average of all possible split-half reliability coefficients. A calculated alpha coefficient will vary between 1 (denoting perfect internal reliability) and 0 (denoting no internal reliability). It can be cited that a construct can exhibit good reliability even if it does not satisfy convergent validity criteria. Cronbach's coefficient is considered to be a good measure of reliability (Bryman and Bell, 2007; Sreejesh and Mohapatra, 2014).

The extent to which the data collection and analytical statistic approaches will yield consistent findings needs to be determined. The value of Cronbach's alpha must be greater than 0.7 in order to meet the result criterion. In other words, it can be recommended that suggesting acceptable reliability of the Cronbach's alpha for the hypothesised constructs is above 0.70. In addition to the assessment of reliability implementing Cronbach's Coefficient Alpha, the research studies also analysed the value of "composite reliability", which is also recognised as "construct reliability" for each latent variable. Similarly, analysis for the confidence (Reliability) of measured variables with the confidence coefficients of Cronbach's alpha, and analysis of the questionnaire by Corrected Item-Total Correlation (CITC) were carried out. It can be seen that all of the values in the major factors of measured variables with the reliability criteria are above the 0.70 inception (**bold lettering**). In the form of the CITC, all of the factors are also over 0.20 (Bryman and Bell, 2007; Sreejesh and Mohapatra, 2014). The details of the

outcomes are depicted in the Table 5.5: The consequences of Reliability in the Measured Variables. That means all of the results indicating the scales in this research study are reliable.

Table 5.5: The consequences of Reliability in the Measured Variables

Measured Variables in each Factor	Cronbach's Alpha	CITC
Service Quality		
1. Service Factors	**0.924**	
The convenience of using the expressway		0.570
Quickness in passing through the pay stations including Easy Pass		0.546
Short travel time on expressways relative to other routes		0.651
Appropriate Fare		0.476
Good feeling using expressways (emergency phones)		0.542
Confidence in using expressways (free accident services)		0.550
2. Safety Factors	**0.876**	
Confidence due to CCTV monitoring traffic conditions & incidents		0.391
The sufficiency of traffic signs to display traffic signals		0.652
The clarity of traffic signs to display traffic signals		0.690
The safety of junctions on expressways		0.840
The safety of expressway ramps connecting to non-express roads		0.759
Feeling of safety whilst driving on the expressways		0.749
3. Operation Factors	**0.861**	
Sufficient networking of expressways		0.542
Efficiency of toll collection systems (including Easy Pass)		0.638
Traffic management		0.770
The cleanliness of expressways		0.621
The predictability of travel time		0.832
Information regarding traffic conditions & events through VMS		0.524
Perceived Value	**0.867**	
Value for money		0.705
Saving travel time		0.807
Improving the quality of the traveller's life		0.734
Satisfaction	**0.826**	
Overall Satisfaction with Service Factors		0.648
Overall Satisfaction with Safety Factors		0.583
Overall Satisfaction with Operation Factors		0.634
Overall Satisfaction with expressways		0.771
Behaviour Intentions	**0.885**	
Willingness to use the expressways frequently		0.842
Willingness to recommend the EXAT (facilities) to other people		0.843
Willingness to travel despite fare increases		0.699

5.11 Chapter Summary

As stated earlier, the key factors of Perceived Value (PV), Service Quality (SQ) and Satisfaction (SA) have been discussed and modelled. Not only are the constructs as SQ, PV and SA modelled, but the concluding model also comprise Behavioural Intentions (BI). Then, a generated idea linking between the Public-Private Partnership (PPP) concepts, Customer Satisfaction (CS) approaches, and both of System Dynamics (SD) and Structural Equation Modelling (SEM) theories is revised as the conceptual model.

Further, this strategic approach is innovative in cases of conducting research studies with providing a mechanism for modelling the **relationship** between "**SQ**" and "**SA**" transferring the academic knowledge from CS to US. This means that there is the "**Academic Knowledge Transfer**" in terms of customers and deliveries of SQ on the side of marketers. The major variables of PV, SQ, and SA have been argued and constructed. The model has initially been constructed as SQ, PV and SA, and then the concluding model consists of Behavioural Intentions. Behavioural Intentions (BI) have been discussed in depth in cases of marketing literature articles; however, **few** experimental research **studies** have been established in transport and construction engineering management.

Theoretically, this research approach meets the terms of "**Modelling** User Satisfaction with Transportation Public-Private Partnership Projects" as summarised in the title of this thesis as well as attempting to attain the research questions, aim, and objectives.

The next chapter of this research study reports all results of the Expressway Authority of Thailand (EXAT) users and officials from the surveyed questionnaire. The outcomes of the perceived satisfaction of the EXAT users and officials are also illustrated and detailed.

CHAPTER SIX
QUESTIONNAIRE SURVEY ANALYSIS

6.1 Introduction

This chapter reports the results of the Expressway Authority of Thailand (EXAT) users and officials from the survey questionnaire. The outcomes are described by reference to the context, with figures, tables, and the models of perceived satisfaction of the users and officials as part of the key stakeholders which are already mentioned in the former chapters. It is also based on the cases of the involved people as they are the stakeholders.

A major aim of this chapter is to generate the analysed models of user satisfaction with PPP by using data based on the BTS and EXAT case study researches. The projects from the surveyed questionnaire are established as PPP projects.

Additionally, the analysis of perceived satisfaction with the EXAT services is reported, identified, and the benefits associated with the projects are evaluated. The study in terms of the level of perceived satisfaction using the EXAT services from its users/drivers and the members of staff with experiencing the EXAT projects from stakeholders can be classified by the features as described in the next section.

6.2 The Characteristic Analysis Results of the EXAT Users and Officials

As shown in Table 6.1, the total number of EXAT-user questionnaires analysed was 561. The questionnaire was responded to by Thai car users who only used the Thai version of the questionnaire as in Appendix C. Fifty two (52) EXAT officials were also surveyed, as reported in Table 6.1. This Table includes the data on gender, age, occupation, monthly income, main reasons for using the services, frequency of use and types of payment for both EXAT users and officials.

Gender and Age

Of the 561 EXAT users, there were 245 female drivers (43.7%), 292 male drivers (52.0%), and 24 drivers (4.3%) who preferred not to give their gender. The age range is presented

in four bands, in line with the Thai Motor Act regarding automobile insurance in Thailand (OIC, 2015). There were 230 users whose ages were between 18 and 35, forming the largest group (41%). The number of 36-50 year-old drivers was 197 (35.1%), and 104 people (18.5%) were in the age range 51-60. The smallest group, 30 people (5.3%), were older than 60 years. In addition to the 52 EXAT officials, there were 25 females (48.1%) and 27 males (51.9%). The age ranges were sorted into four bands, thus similar to the EXAT-user questionnaires. There were 36 members of staff whose ages were between 18 and 35, forming the largest group (69.2%). The number of 36-50 year-old officials was 13 (25.0%), and 3 members of staff (5.8%) were between 51 and 60. There was no one older than 60 years of age. (See Figure 6.1)

Occupation

A total of 114 students (20.3%) responded to the questionnaire. The number of government officials, apart from the 52 EXAT officials, was 143 (25.5%). The biggest group was formed of 223 Company employees (39.8%). A total of 78 drivers (13.9%) were business owners. A very small group comprising three people (0.5%), gave 'other' occupations including household duties. (See Figure 6.1)

Monthly Income (Baht)*

In relation to monthly income, four levels were delineated. There were 125 users (22.3%) and 22 officials (42.3%) who had less than 15,000 Baht a month. The numbers of drivers and staff who earned between 15,001 Baht and 25,000 Baht were 186 (33.2%) and 19 (36.5%) respectively. For the EXAT users, they formed the largest group. Similar numbers of EXAT users earned between 25,001-50,000 Baht, that is 178 (31.7%), but a smaller proportion of officials, only nine people (17.3%). Finally, 72 people (12.8%) and only two members of EXAT staff (3.8%) replying to this survey earned more than 50,000 Baht per month. (See Figure 6.1)

Note: 1 British Pound = 51.87 Thai Baht (BOT, 2016)

The Main Reason for Using EXAT Services

The questionnaire asked respondents to indicate the main reason or purpose for using the EXAT services, but they were allowed to indicate as many as applied. Therefore, the numbers are the totals for each type of purpose. A total of 247 users (32%) and 28 officials (34.6%) used EXAT services in order to get to where they studied or worked.

Similarly, 224 people (29.0%) and 21 EXAT staff (25.9%) used them to go home. A total of 114 drivers (14.8%) and 13 officials used them for shopping whilst 169 users (21.9%) and 16 members of staff (19.8%) specified the main use was for doing business. A very small proportion said the main use was for other activities such as travelling, meeting friends, and visiting family/relatives. There were 18 users (2.3%) and three officials (3.7%) in this group. (See Figures 6.1 and 6.2)

Frequency of Use

The questionnaire asked respondents to indicate how many times they travelled by expressways in one week. The data were categorised into two main groups: those travelling "from one to six times" and "more than or equal to seven times ($\geqslant$ 7 times). There were 407 users (72.5%) and 46 officials (88.5%) travelling by the expressways one to six times a week, and 154 drivers (27.5%) and six members of staff (11.5%) travelling seven or more than seven times a week. (See Figures 6.1 and 6.2)

Payment

Finally, respondents were asked which type of payment they used. There are two types of payment methods which are (i) by cash and (ii) by Easy Pass, which is the new way for payment of the toll at the toll stations (EXAT, 2016). There were 333 users (59.4%) and 26 officials (50.0%) who paid for the EXAT services by cash; 228 drivers (40.6%) and 26 members of staff (50%) paid by Easy Pass. (See Figures 6.1 and 6.2)

Table 6.1: Demographic and Usage Characteristics of EXAT Users and Officials

Characteristics		561 EXAT users		52 EXAT officials	
		Number	Percentages	Number	Percentages
1. Gender	Female	245	43.7	25	48.1
	Male	292	52.0	27	51.9
	Prefer not to say	24	4.3		
2. Age (years)	18-35	230	41.0	36	69.2
	36-50	197	35.1	13	25.0
	51-60	104	18.5	3	5.8
	Older than 60	30	5.3		
3. Occupation	Student	114	20.3	52	100.0
	Government Official	143	25.5		
	Company Employee	223	39.8		
	Business Owner	78	13.9		
	Other (e.g. Household duties)	3	0.5		
4. Monthly Income (Baht)	Less than 15,000	125	22.3	22	42.3
	15,001-25,000	186	33.2	19	36.5
	25,001-50,000	178	31.7	9	17.3
	More than 50,000	72	12.8	2	3.8
5. The main reason for using EXAT services *(Please mark as many as apply)*	To study / work	247	32.0	28	34.6
	To go home	224	29.0	21	25.9
	To go shopping	114	14.8	13	16.0
	To do business	169	21.9	16	19.8
	Other	18	2.3	3	3.7
	total	772	100.0	81	100.0
6.Travels by expressways per week(time(s))	1-6 times	407	72.5	46	88.5
	≥ 7 times	154	27.5	6	11.5
		M = 5.24	*SD = 4.41*	*M = 3.63*	*SD = 3.54*
7. Payment	Cash	333	59.4	26	50.0
	Easy Pass	228	40.6	26	50.0

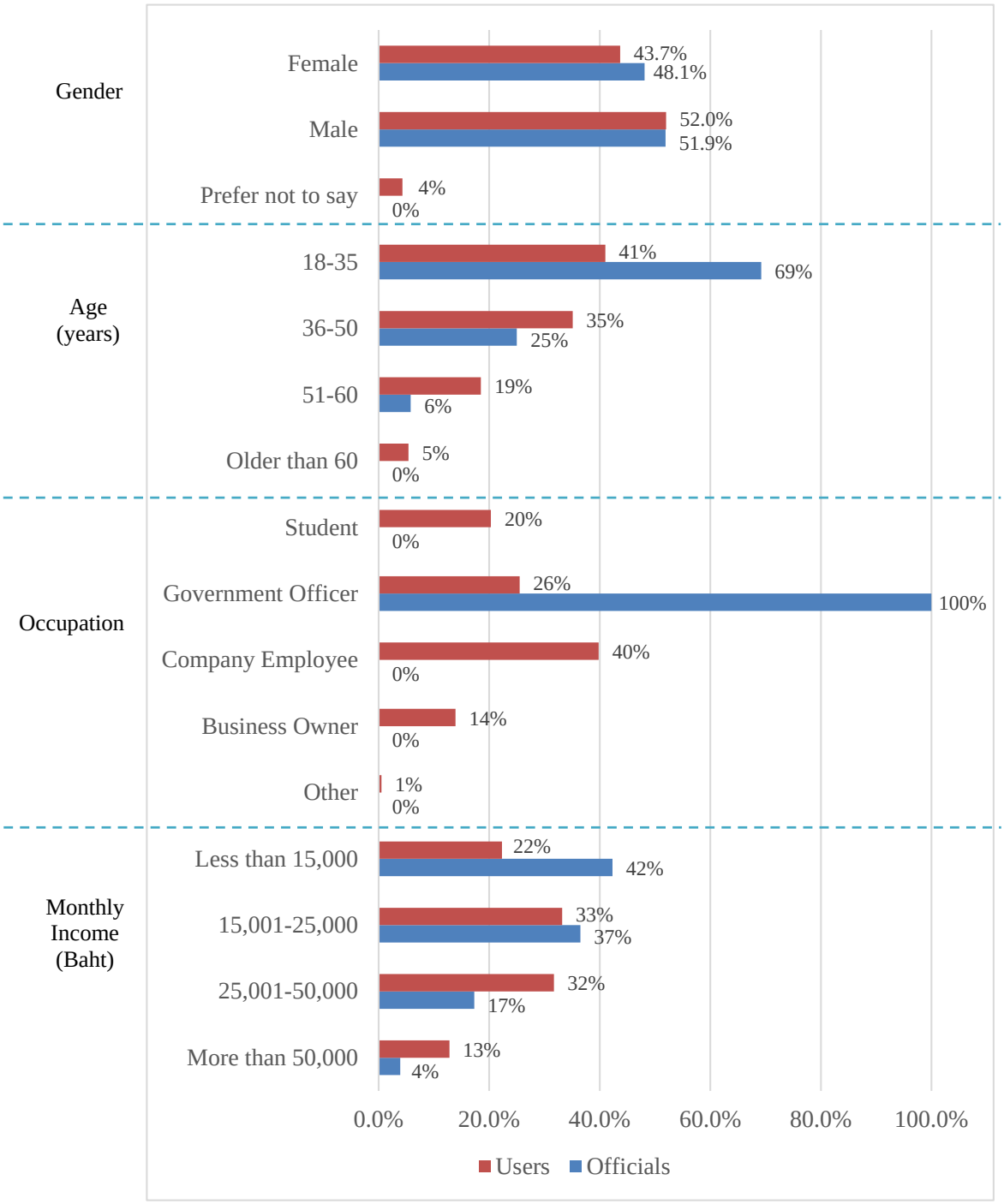


Figure 6.1: Demographic Profile of EXAT Users and Officials

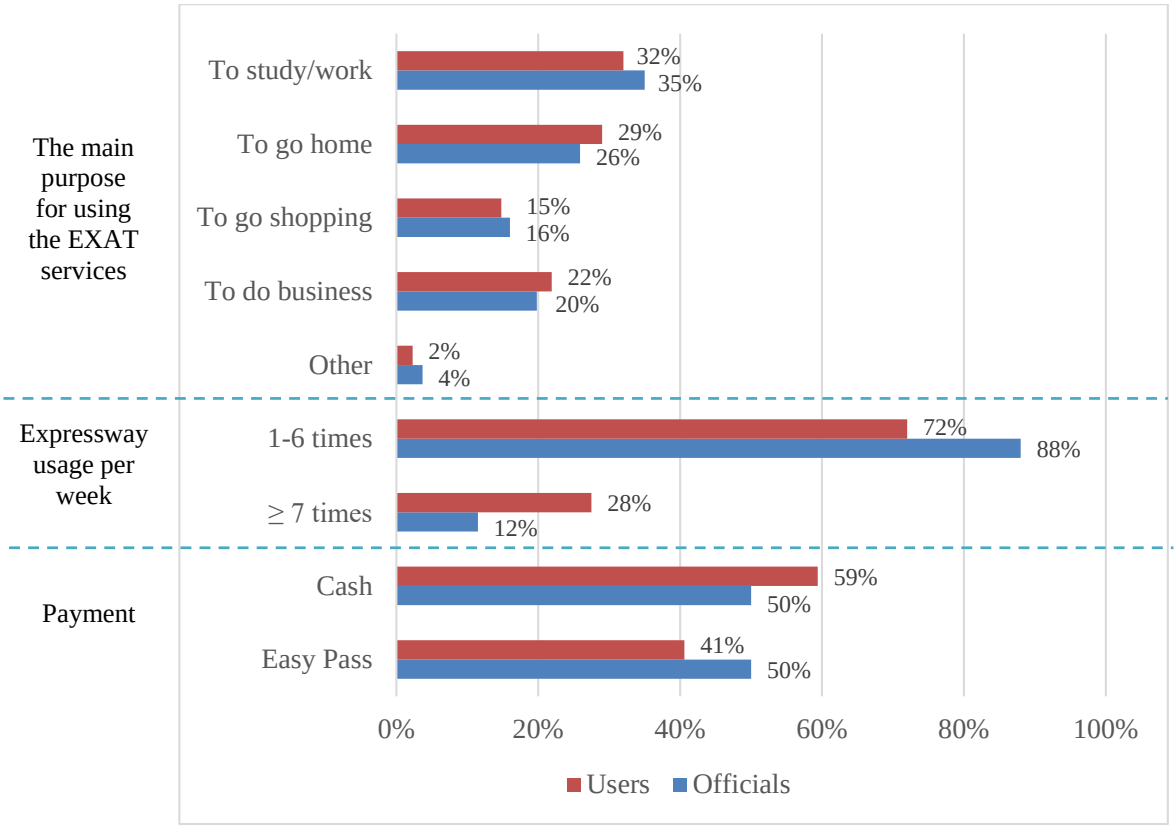


Figure 6.2: Usage Characteristics of EXAT users and officials

6.3 The Analysis of the Perceived Satisfaction with the EXAT Facilities

When defining and mapping the EXAT stakeholders, it is found that the primary stakeholders are EXAT users and officials as well as experts (including senior experts) in the research study (Tangkitsiri and Ogunlana, 2004; Tangkitsiri *et al.*, 2013b; BTS, 2015; EXAT, 2015; and MOT, 2015). As a consequence, this research studies the perceived satisfaction with the EXAT facilities.

This chapter focuses on the perceived satisfaction of the EXAT users and officials. The questionnaire survey results of the perceived satisfaction with the EXAT Facilities were analysed using statistical programmes, i.e. (i) Microsoft Excel and (ii) Statistical Package for the Social Sciences (SPSS) for the "Descriptive Analysis".

The following chapter (Chapter Six Structural Equation Modelling) explicates and models the findings represented by the SEM diagrams of perceived satisfaction of the EXAT users with being interviewed and reviewed by experts (including senior experts). The statistical software package for analysing the SEM model is LInear Structural RELationships (LISREL).

In order to discover the expectations of the significant stakeholders and to categorise each question in the A4 questionnaire based on similar dimensions of Service Quality (SQ or SERVQUAL), it is effectively demonstrated in Table 5.3. There is a direct correlation between "Service Quality (SQ) Factors" in this research study and "Scale Dimensions" adapted from Parasuraman *et al.* (1988), Zeithaml *et al.* (1990), and the Table 2.1: Service Quality (SQ) Scale Dimensions for Customers/Users.

Descriptive Analysis

The 561 EXAT *Users* and 52 EXAT *officials* from this questionnaire survey as part of the quantitative approach are satisfied with the EXAT facilities. The questionnaire is designed as a five-point Likert scale ranging from "High Level of Satisfaction (5) to Low Level of Satisfaction (1)" for ease of rating (Likert, 1932; Tangkitsiri and Ogunlana, 2004; Armitage and Conner, 2001; and Norman, 2010).

From the questionnaire, the three primary factors were service (SQ1), safety (SQ2), and operation (SQ3). These primary factors (indicators or observed/measured variables) are established as the Service Quality (SQ) factor in the SEM model (SQ is part of the four major factors). Similarly, the four major factors are SQ, PV, SA, and BI being found and formed as latent variables/constructs in the SEM model.

All of the factors (variables or constructs) are measured by the level of perceived satisfaction via the questionnaire. In addition, these factors are analysed by the statistical programmes as mentioned for the descriptive analysis including Mean (M) and Standard Deviation (SD). The outcomes of the perceived satisfaction are reported in the two following sections: (i) users in section 5.4; and (ii) officials in section 6.5.

6.4 The Results of the *User* Perceived Satisfaction in Each Factor

The perceived satisfaction of the users was first studied in relation to Service Quality (SQ). From the questionnaire, as established already, the three primary factors were (i) service (SQ1), (ii) safety (SQ2), and (iii) operation (SQ3).

The descriptive analysis revealed that the mean scores for the perceived satisfaction of the SQ1, SQ2, and SQ3 are 3.74, 3.67, and 3.61 consecutively. Additionally, the analysis of each variable of SQ factors is shown in Table 6.2: User Perceived Satisfaction in Service Quality (SQ: SQ1; SQ2; SQ3). As a result, the average of SQ1, SQ2, and SQ3 is (3.74+3.67+ 3.61)/3 = 3.67 = SQ.

Next, as already stated in the questionnaire and Table 6.4, each of the Satisfaction (SA) factors is *Overall Satisfaction with* ***Service Factors*** (SA1)***, Safety Factors*** (SA2)***, Operation Factors*** (SA3)***,*** and ***expressways*** (SA4). The mean scores for the perceived satisfaction of the SA1, SA2, SA3 and SA4 are 3.74, 3.65, 3.60, and 3.65 respectively. As a consequence, the average of SA1, SA2, and SA3 is (3.74+3.65+ 3.60)/3 = **3.66** which is **nearly** identical to *Overall Satisfaction with* ***expressways*** (SA4) = **3.65**.

This means that the cross analysis results of SA are still reliable and valid. In addition, the analysis of each variable of SA factors is demonstrated in Table 6.3: User Perceived Satisfaction in Satisfaction (SA: SA1; SA2; SA3; SA4).

Similarly, when comparing the results of the mean scores for the perceived satisfaction between SQ and SA, the values are also **extremely** comparative, i.e. **SQ1=3.74; SA1= 3.74**, SQ2=3.67; SA2=3.65, and SQ3=3.61; SA3=3.60. Correspondingly, the outcomes of the average SQ and the average SA are 3.67 and 3.66 successively

Table 6.2: *User* Perceived Satisfaction in Service Quality (SQ: SQ1; SQ2; SQ3)

SQ	1	2	3	4	5	*M*	*SD*
SQ1_1	1 0.2%	7 1.2%	104 18.5%	312 55.6%	137 24.4%	4.03	.704
SQ1_2	4 0.7%	21 3.7%	138 24.6%	294 52.4%	104 18.5%	3.84	.789
SQ1_3	2 .4%	26 4.6%	148 26.4%	274 48.8%	111 19.8%	3.83	.807
SQ1_4	29 5.2%	66 11.8%	216 38.5%	195 34.8%	55 9.8%	3.32	.981
SQ1_5	6 1.1%	38 6.8%	177 31.6%	259 46.2%	81 14.4%	3.66	.845
SQ1_6	3 .5%	27 4.8%	172 30.7%	262 46.7%	97 17.3%	3.75	.813
SQ1						3.74	.600
SQ2_1	1 .2%	26 4.6%	174 31.0%	265 47.2%	95 16.9%	3.76	.791
SQ2_2	4 .7%	23 4.1%	192 34.2%	272 48.5%	70 12.5%	3.68	.770
SQ2_3	4 .7%	31 5.5%	189 33.7%	264 47.1%	73 13.0%	3.66	.799
SQ2_4	7 1.2%	49 8.7%	213 38.0%	219 39.0%	73 13.0%	3.54	.872
SQ2_5	4 .7%	40 7.1%	188 33.5%	257 45.8%	72 12.8%	3.63	.823
SQ2_6	3 .5%	27 4.8%	175 31.2%	267 47.6%	89 15.9%	3.73	.801
SQ2						3.67	.651
SQ3_1	9 1.6%	56 10.0%	174 31.0%	260 46.3%	62 11.1%	3.55	.875
SQ3_2	15 2.7%	37 6.6%	176 31.4%	260 46.3%	73 13.0%	3.60	.891
SQ3_3	18 3.2%	53 9.4%	189 33.7%	215 38.3%	86 15.3%	3.53	.969
SQ3_4	3 .5%	23 4.1%	143 25.5%	268 47.8%	124 22.1%	3.87	.820
SQ3_5	22 3.9%	54 9.6%	173 30.8%	228 40.6%	84 15.0%	3.53	.989
SQ3_6	12 2.1%	45 8.0%	187 33.3%	250 44.6%	67 11.9%	3.56	.880
SQ3						3.61	.698

Table 6.3: *User* Perceived Satisfaction in Satisfaction (SA: SA1; SA2; SA3; SA4)

SA	1	2	3	4	5	*M*	*SD*
SA1	2 .4%	17 3.0%	168 29.9%	314 56.0%	60 10.7%	3.74	.701
SA2	2 .4%	18 3.2%	202 36.0%	293 52.2%	46 8.2%	3.65	.692
SA3	10 1.8%	23 4.1%	199 35.5%	278 49.6%	51 9.1%	3.60	.782
SA4	5 .9%	19 3.4%	186 33.2%	309 55.1%	42 7.5%	3.65	.707

Then, each of the Perceived Value (PV) Factors is "Latent Variables" or "Latent Constructs" corresponding to Behaviour Intentions (BI). Both of the PV and BI factors are located in ***4. Other Factors*** in the survey questionnaire.

Accordingly, the mean scores for the perceived satisfaction of PV factors, i.e. PV1, PV2, PV3, and PV are 3.53, 3.81, 3.68, and 3.67 sequentially. Table 6.4 (User Perceived Satisfaction in Perceived Value) clarifies the analysis of each variable of PV factors (PV1, PV2, PV3, and PV).

Table 6.4: *User* Perceived Satisfaction in Perceived Value (PV: PV1; PV2; PV3)

PV	1	2	3	4	5	*M*	*SD*
PV1	10 1.8%	52 9.3%	187 33.3%	257 45.8%	55 9.8%	3.53	.860
PV2	6 1.1%	23 4.1%	149 26.6%	279 49.7%	104 18.5%	3.81	.821
PV3	6 1.1%	33 5.9%	178 31.7%	262 46.7%	82 14.6%	3.68	.833
PV						3.67	.725

Finally, the last latent variable of the four major factors is BI being found and formed as a latent construct in ***4. Other Factors*** in the last section of the questionnaire succeeding to the PV factors. Consequently, each of the Behaviour Intentions (BI) Factors ("Latent Variables" or "Latent Constructs") conforms to PV and SA. The mean scores for the perceived satisfaction of the BI1, BI2, BI3 and BI are 3.78, 3.69, 3.08, and 3.52

respectively. In addition, Table 6.5 (User Perceived Satisfaction in BI) elucidates the analysis of each variable of BI factors (BI1, BI2, BI3, and BI).

Table 6.5: *User* Perceived Satisfaction in Behaviour Intentions (BI: BI1; BI2; BI3)

BI	1	2	3	4	5	*M*	*SD*
BI1	2 .4%	29 5.2%	150 26.7%	292 52.0%	88 15.7%	3.78	.783
BI2	5 .9%	32 5.7%	184 32.8%	249 44.4%	91 16.2%	3.69	.840
BI3	53 9.4%	104 18.5%	188 33.5%	175 31.2%	41 7.3%	3.08	1.078
BI						3.52	.756

6.5 The Results of the *Official* Perceived Satisfaction in Each Factor

As reported by the previous section (6.4), similarly, from the descriptive analysis in this study, it is shown that the mean scores for the perceived satisfaction of the SQ1, SQ2, and SQ3 are 4.05, 3.96, and 3.63 consecutively. Additionally, the analysis of each variable of SQ factors is performed in Table 6.6: Official Perceived Satisfaction in Service Quality (SQ: SQ1; SQ2; SQ3). As a result, the average of SQ1, SQ2, and SQ3 is (4.05+3.96+ 3.63)/3 = 3.88 = SQ.

Next, as already stated in the questionnaire and Table 6.4, each of the Satisfaction (SA) factors is *Overall Satisfaction with* ***Service Factors*** (SA1)***, Safety Factors*** (SA2)***, Operation Factors*** (SA3)***,*** and ***expressways*** (SA4). The mean scores for the perceived satisfaction of the SA1, SA2, SA3 and SA4 are 4.12, 3.94, 3.58, and 4.04 respectively. As a consequence, the average of SA1, SA2, and SA3 is (4.12+3.94+ 3.58)/3 = **3.88** which is **very close** to *Overall Satisfaction with* ***expressways*** (SA4) = **4.04**. This means that the cross analysis results of SA are still reliable and valid. In addition, the analysis of each variable of SA factors is demonstrated in Table 6.7: Official Perceived Satisfaction in Satisfaction (SA: SA1; SA2; SA3; SA4).

Similarly, when comparing the results of the mean scores for the perceived satisfaction between SQ and SA, the values are also **very** comparative, i.e. SQ1=4.05; SA1= 4.12, SQ2=3.96; SA2=3.94, and SQ3=3.63; SA3=3.58. Correspondingly, the outcomes of the average SQ and the average SA are 3.88 and 3.92 successively.

Table 6.6: *Official* Perceived Satisfaction in Service Quality (SQ: SQ1; SQ2; SQ3)

SQ	1	2	3	4	5	*M*	*SD*
SQ1_1	0 0%	1 1.9%	4 7.7%	32 61.5%	15 28.8%	4.17	.648
SQ1_2	0 0%	0 0%	13 25.0%	25 48.1%	14 26.9%	4.02	.727
SQ1_3	0 0%	1 1.9%	6 11.5%	24 46.2%	21 40.4%	4.25	.738
SQ1_4	0 0%	2 3.8%	18 34.6%	25 48.1%	7 13.5%	3.71	.750
SQ1_5	0 0%	2 3.8%	13 25.0%	22 42.3%	15 28.8%	3.96	.839
SQ1_6	0 0%	1 1.9%	9 17.3%	22 42.3%	20 38.5%	4.17	.785
SQ1						4.05	.541
SQ2_1	0 0%	1 1.9%	8 15.4%	26 50.0%	17 32.7%	4.13	.742
SQ2_2	0 0%	2 3.8%	15 28.8%	23 44.2%	12 23.1%	3.87	.817
SQ2_3	0 0%	1 1.9%	14 26.9%	23 44.2%	14 26.9%	3.96	.791
SQ2_4	0 0%	4 7.7%	12 23.1%	24 46.2%	12 23.1%	3.85	.872
SQ2_5	0 0%	3 5.8%	13 25.0%	22 42.3%	14 26.9%	3.90	.869
SQ2_6	0 0%	0 0%	11 21.2%	26 50.0%	15 28.8%	4.08	.710
SQ2						3.96	.647
SQ3_1	1 1.9%	8 15.4%	19 36.5%	19 36.5%	5 9.6%	3.37	.929
SQ3_2	0 0%	5 9.6%	17 32.7%	24 46.2%	6 11.5%	3.60	.823
SQ3_3	1 1.9%	6 11.5%	18 34.6%	23 44.2%	4 7.7%	3.44	.873
SQ3_4	0 0%	1 1.9%	8 15.4%	26 50.0%	17 32.7%	4.13	.742
SQ3_5	1 1.9%	5 9.6%	14 26.9%	21 40.4%	11 21.2%	3.69	.981
SQ3_6	2 3.8%	4 7.7%	16 30.8%	22 42.3%	8 15.4%	3.58	.977
SQ3						3.63	.622

Table 6.7: *Official* Perceived Satisfaction in Satisfaction (SA: SA1; SA2; SA3; SA4)

SA	1	2	3	4	5	*M*	*SD*
SA1	0 0%	0 0%	8 15.4%	30 57.7%	14 26.9%	4.12	.646
SA2	0 0%	1 1.9%	11 21.2%	30 57.7%	10 19.2%	3.94	.698
SA3	1 1.9%	4 7.7%	16 30.8%	26 50.0%	5 9.6%	3.58	.848
SA4	0 0%	1 1.9%	9 17.3%	29 55.8%	13 25.0%	4.04	.713

Then, as described in the previous section, each of the Perceived Value (PV) Factors is "Latent Variables" or "Latent Constructs" corresponding to Behaviour Intentions (BI). Both of the PV and BI factors are located in ***4. Other Factors*** in the questionnaire.

Consequently, the mean scores for the perceived satisfaction of PV factors, i.e. PV1, PV2, PV3, and PV are 3.88, 4.19, 4.06, and 4.04 sequentially. Table 6.8 (Officials Perceived Satisfaction in Perceived Value) clarifies the analysis of each variable of PV factors (PV1, PV2, PV3, and PV).

Table 6.8: *Official* Perceived Satisfaction in Perceived Value (PV: PV1; PV2; PV3)

PV	1	2	3	4	5	*M*	*SD*
PV1	0 0%	1 1.9%	12 23.1%	31 59.6%	8 15.4%	3.88	.676
PV2	0 0%	1 1.9%	6 11.5%	27 51.9%	18 34.6%	4.19	.715
PV3	0 0%	2 3.8%	7 13.5%	29 55.8%	14 26.9%	4.06	.752
PV						4.04	.630

Lastly, the fourth latent variable of the four major factors is BI being found and formed as a latent construct in ***4. Other Factors*** in the last section of the questionnaire succeeding to the PV factors. Accordingly, each of the Behaviour Intentions (BI) Factors ("Latent Variables" or "Latent Constructs") conforms to PV and SA. The mean scores for the perceived satisfaction of the BI1, BI2, BI3 and BI are 4.31, 3.48, and 4.02 respectively.

Additionally, Table 6.9 (Official Perceived Satisfaction in BI) interprets the analysis of each variable of BI factors (BI1, BI2, BI3, and BI).

Table 6.9: *Official* Perceived Satisfaction in Behaviour Intentions (BI; BI1; BI2; BI3)

BI	1	2	3	4	5	*M*	*SD*
BI1	0 0%	0 0%	7 13.5%	22 42.3%	23 44.2%	4.31	.701
BI2	0 0%	0 0%	8 15.4%	22 42.3%	22 42.3%	4.27	.717
BI3	2 3.8%	4 7.7%	20 38.5%	19 36.5%	7 13.5%	3.48	.960
BI						4.02	.684

6.6 Modelling the Levels of Satisfaction between the Users and Officials

"Modelling User Satisfaction with Transportation Public-Private Partnership (PPP) Projects" is designated as the subject and object of the research study to achieve the User Satisfaction (US) in understanding of PPP projects with a view to improved Customer Satisfaction (CS). As itemised in the research aim and objectives for this thesis, it is imperative to understand user satisfaction. Hence, models for assessing the satisfaction of users have been established and developed.

First of all, an effective way of generating the model of the user satisfaction with PPP is to use data based on the BTS and EXAT case study researches. Figure 6.3 illustrates the overlapping area from the two circles which indicates the "perceived satisfaction" between EXAT services and the needs of stakeholders mainly focusing on the EXAT users and officials. Then, the SEM diagrams are analysed and explicated in the subsequent chapter (Chapter Six Structural Equation Modelling).

EXAT is the service provider and policy maker. Similarly, each relevant stakeholder in the EXAT system also possesses a certain set of expectations. If the service provided by EXAT to the individual is well accepted, it is likely that the recipient will be satisfied with EXAT services on the aspects (SQ, SA, PV, and BI). The levels of satisfaction are related to the extent of achievement of the perceived benefits.

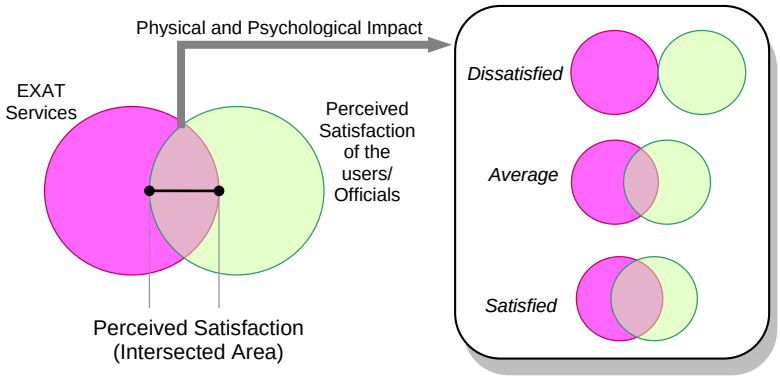


Figure 6.3: Modelling Levels of the User/Official Perceived Satisfaction

Adapted from Figure 5.1: Modelling the Levels of Satisfaction between the Users and Officials

This extent of the perceived satisfaction concerns both physical and psychological aspects being measured through the questionnaire. In addition, figure 6.3 displays each physical and psychological condition by the area of intersection between EXAT services and the perceived satisfaction of the EXAT users and officials. Nonetheless, the research study in this thesis concentrates on the perceived satisfaction of users, officials, and experts since they play the roles of major stakeholders.

As mentioned in section 4.12 (Data Analysis), analyses of the extent of the perceived satisfaction are used to address the research questions and support the aim and objectives. These are also significant and relative to the perceived satisfaction of the EXAT users and officials. As a consequence, Levene's Test, ANOVA, and Mann-Whitney U Test have been used to model the perceived satisfaction levels between the users and officials.

According to Hair *et al*. (2010) and Cooper and Schindler (2014), ANalysis Of VAriance (ANOVA) is a statistical technique used to determine whether samples from two or more groups come from populations with equal means. In other words, the means of several independent populations are equal. In addition, ANalysis Of VAriance (ANOVA) examines and determines one dependent measure whereas Multivariate Analysis of Variance (MANOVA) compares group differences on two or more dependent variables. Thus, the ANOVA test is a statistical method performed to analyse effects of categorical factors. This test can be used to analyse two groups or more than two groups. Essentially, they are also equivalent to t-test (two groups) and F-test (more than two groups).

Furthermore, Hair *et al*. (2010) argued that the statistical tests for equal variance dispersion assess the equality of variances within groups formed by nonmetric variables. The most universal test is Levene's test. This test is used to assess whether the variances of a single metric variable are equal across any number of groups. That means, a t-test has performed with separate variance estimates rather than pooled (combined) variance estimates since the Levene's test has detected significant differences in the variations between the two groups.

In this thesis, respondents were classified according to factors such as gender, age, and occupation. These classes were implemented to test if there were any significant differences in the mean of responses (between groups) when conducting the field questionnaire survey.

The Level of Significance, i.e. Significance Level, is significant at 0.01 (or sometimes 0.05 for a field study or survey). This is associated with the statistical testing (p-value) of the differences between two or more groups. Characteristically, the small values such as 0.05 or 0.01 are specified to minimise the possibility of making an error (Hair *et al*., 2010).

In addition, Hair *et al*. (2010) stated that the analysis results of the Levene's test involve analysing the collected data with each variable that has a total score of each item. Due to the difference of the test between the average of the variable characteristics of the respondents, the analysis of t-test or ANOVA must be examined and determined on Equal Variance before deciding whether to employ the t-test (two groups) or F-test (more than two groups).

Fundamentally, the comparison between the two groups uses t-test such as groups of users and officials, gender, frequency of use, and payment. If there were more than two groups (the number of the groups $\geqslant 3$), e.g. having the third group, ANOVA would be used as the F-test.

As a result, the outcomes of the user and official satisfaction in this section are also analysed by Levene's test (Equal Variance Test) and ANOVA (Mean Different Test) as well as described in Table 6.10: Levels of Satisfaction between the Users and Officials in Each Factors.

Table 6.10: Levels of Satisfaction between the Users and Officials in Each Factor

Factors	Major EXAT Stakeholders	Descriptive Statistics			Equal Variance Test		Mean Different Test	
		Count	M	SD	Levene's test	p-value	t-test	p-value
SQ1	Users	561	3.74	.600	0.398	0.528	12.761	0.000**
	Officials	52	4.05	.541				
SQ2	Users	561	3.67	.651	0.132	0.716	9.934	0.002**
	Officials	52	3.96	.647				
SQ3	Users	561	3.61	.698	1.803	0.180	.070	0.792
	Officials	52	3.63	.622				
SA	Users	561	3.66	.595	0.387	0.534	9.021	0.003**
	Officials	52	3.92	.579				
PV	Users	561	3.67	.725	1.712	0.191	12.979	0.000**
	Officials	52	4.04	.630				
BI	Users	561	3.52	.756	1.798	0.180	21.265	0.000**
	Officials	52	4.02	.684				

*Note: *Significant at 0.05 Significance Level; **Significant at 0.01 Significance Level*

As reported by the characteristics of "gender", "frequency of use", and "age", each result of the tests of both Equal Variance and Mean Different in all SQ, SA, PV, and BI factors is not significant either at 0.05 or at 0.01 Significance Levels.

It can be concluded that the characteristics of EXAT respondents have not had the correlated impact of gender, frequency of use, and age on the tests in the research study since all of them are not significant at any level. These are also explicated in Tables 6.11, 6.12, and 6.13: Satisfaction Levels of the Significant Characteristic and Factors in gender, frequency of use, and age consecutively. Nevertheless, the other respondent characteristics have effects on levels of perceived satisfaction of the users and officials in factors, and they are reported by the "Kruskal-Wallis" test. The outcomes of the interrelated impact are analysed by the Kruskal-Wallis Chi-square Test and explained in the following section.

Table 6.11: Satisfaction Levels of the Gender Characteristic and Factors

Factors	Gender	Descriptive statistics			Equal Variance Test		Mean Different Test	
		Count	M	SD	Leven's test	p-value	t-test	p-value
SQ1	Male	319	3.76	.614	.287	.592	.052	.819
	Female	270	3.75	.589				
SQ2	Male	319	3.71	.676	.594	.441	.543	.461
	Female	270	3.67	.638				
SQ3	Male	319	3.62	.722	2.422	.120	.551	.458
	Female	270	3.58	.661				
SA	Male	319	3.69	.613	.201	.654	.328	.567
	Female	270	3.66	.582				
PV	Male	319	3.72	.746	1.450	.229	1.104	.294
	Female	270	3.66	.703				
BI	Male	319	3.58	.764	.046	.831	.977	.323
	Female	270	3.52	.759				

*Note: ***NO Significant at 0.05 and 0.01 Significance Levels; excluding the 24 responses in the "Prefer not to say" in the "Gender" category of Characteristics.*

Table 6.12: Satisfaction Levels of the Frequency Characteristic and Factors

Factors	Usage Frequency (time(s))	Descriptive statistics			Equal Variance Test		Mean Different Test	
		Count	M	SD	Levene's test	p-value	t-test	p-value
SQ1	1-6	453	3.75	.589	1.124	.289	1.231	.268
	⩾ 7	160	3.81	.631				
SQ2	1-6	453	3.68	.647	1.738	.188	.320	.572
	⩾ 7	160	3.72	.682				
SQ3	1-6	453	3.61	.688	.138	.710	.049	.825
	⩾ 7	160	3.60	.704				
SA	1-6	453	3.68	.599	.018	.893	.041	.841
	⩾ 7	160	3.67	.597				
PV	1-6	453	3.69	.711	.403	.526	.180	.671
	⩾ 7	160	3.72	.762				
BI	1-6	453	3.54	.758	.111	.739	.793	.374
	⩾ 7	160	3.61	.776				

*Note: ***NO Significant at 0.05 and 0.01 Significance Levels.*

Table 6.13: Satisfaction Levels of the Age Characteristic and Factors

Factors	Age (years)	Descriptive statistics			Equal Variance Test		Mean Different Test	
		Count	M	SD	Leven's test	p-value	F-test	p-value
SQ1	18-35	266	3.78	.613	1.633	.181	.336	.800
	36-50	210	3.73	.633				
	51-60	107	3.79	.533				
	Older than 60	30	3.78	.494				
SQ2	18-35	266	3.74	.626	1.409	.239	1.114	.343
	36-50	210	3.63	.717				
	51-60	107	3.69	.616				
	Older than 60	30	3.71	.598				
SQ3	18-35	266	3.63	.661	3.592	.140	.154	.927
	36-50	210	3.59	.771				
	51-60	107	3.60	.630				
	Older than 60	30	3.62	.594				
SA	18-35	266	3.71	.585	3.381	.180	1.028	.382
	36-50	210	3.62	.658				
	51-60	107	3.71	.503				
	Older than 60	30	3.75	.571				
PV	18-35	266	3.74	.712	2.512	.058	.757	.518
	36-50	210	3.66	.794				
	51-60	107	3.67	.629				
	Older than 60	30	3.81	.635				
BI	18-35	266	3.59	.755	.964	.409	.390	.761
	36-50	210	3.54	.807				
	51-60	107	3.51	.716				
	Older than 60	30	3.58	.694				

*Note: ***NO Significant at 0.05 and 0.01 Significance Levels.*

6.7 The Relationships between the Characteristics and the Factors

As mentioned previously, several characteristics of respondents have effects on the levels of perceived satisfaction of the users and officials each factor (SQ1, SQ2, SQ3, SA, PV, and BI). The outcomes of the interrelated impact are analysed by the Kruskal-Wallis Chi-square Test and explained in this part and listed in the Tables 6.14 to 6.19.

As mentioned by Cooper and Schindler (2014), the tests of Kruskal-Wallis and Mann-Whitney U are considered by the cross analysis research strategy in cases of "Mean Rank" and "Rank-Order" Tests. In other words, the Kruskal-Wallis Test is a one-way ANalysis Of VAriance (ANOVA) by ranks. This is also a generalised version of the Mann-Whitney U Test. This means that the analyses of descriptive statistics such as Mean and Standard Deviation (SD) are selected to support the research study in terms of the statistical findings. These are also significant and relative to the perceived satisfaction of the EXAT users and officials. As a result, Mann-Whitney U Test is principally employed to model the perceived satisfaction levels between the users and officials in cases of "Rank-Order" Tests as explicated in the consequent section.

According to Hair *et al*. (2010), it is suggested that the Kruskal-Wallis Chi-square (χ^2) test is required to examine and determine the relationship between characteristics of the EXAT respondents and the SQ, SA, PV, and BI factors. These factors, i.e. (i) service, (ii) safety, (iii) operation, and (iv) other factors, are in the form of the A4 questionnaire and categorised in Table 5.4: Code or Name for Each Question in the Questionnaire. The "Significance Level" is also significant at 0.01 (or sometimes 0.05 for a field study or survey). This is associated with the statistical testing (p-value or "p") of the differences between two or more groups.

In this research study, the key stakeholders are EXAT users and officials as part of the groups of the characteristics of respondents. These are composed of gender, age, occupation, income, frequency, and payment. As reported in the preceding section, similarly, it can methodically be concluded that the characteristics of EXAT respondents have not had the correlated impact of "Gender", "Age", and "Frequency" on the tests since all of them are not significant at any level. These are also elucidated in Tables 6.14 to 6.19.

Table 6.14: The Relationships between the Characteristics and the Factors of SQ1

SQ1	Stakeholder		*Gender*		*Age*		*Occupation*		*Income*		*Frequency*		*Payment*	
	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p
SQ1_1	2.196	.138	.062	.970	.655	.884	7.679	.069	8.052	**.045***	0.056	.812	0.326	.568
SQ1_2	1.830	.176	2.351	.309	2.991	.393	6.427	.162	2.588	.460	0.296	.586	11.194	**.001****
SQ1_3	13.549	**<.001****	1.186	.553	.712	.870	13.387	**.002****	0.604	.895	1.234	.267	3.645	.056
SQ1_4	7.370	**.007****	.001	.999	1.150	.765	23.125	**.003****	9.813	**.020***	0.776	.379	7.131	**.008****
SQ1_5	5.636	**.018***	2.999	.223	3.984	.263	15.457	**.001****	5.100	.165	1.126	.289	0.778	.378
SQ1_6	12.667	**<.001****	1.464	.481	2.017	.569	11.733	**.004****	5.780	.123	3.197	.074	1.719	.190

*Note: *Significant at 0.05 Significance Level; **Significant at 0.01 Significance Level*

Table 6.15: The Relationships between the Characteristics and the Factors of SQ2

SQ2	Stakeholder		Gender		Age		Occupation		Income		Frequency		Payment	
	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p
SQ2_1	10.891	**.001****	.440	.803	.615	.893	19.053	**<.001****	6.529	.089	0.268	.605	1.827	.176
SQ2_2	2.468	.116	.019	.991	3.486	.323	17.132	.102	10.021	**.018***	0.072	.789	2.707	.100
SQ2_3	6.023	**.014***	.864	.649	1.283	.733	11.585	**.015****	6.939	.074	0.160	.689	4.254	**.039***
SQ2_4	6.227	**.013***	1.783	.410	2.492	.477	12.801	**.002****	9.802	**.020***	0.000	.996	7.404	**.007****
SQ2_5	5.066	**.024***	1.695	.429	3.163	.367	15.064	**<.001****	8.141	**.043***	0.063	.801	5.817	**.016***
SQ2_6	8.274	**.004****	5.251	.072	1.683	.641	10.055	.081	3.397	.334	1.291	.256	5.480	**.019***

*Note: *Significant at 0.05 Significance Level; **Significant at 0.01 Significance Level*

Table 6.16: The Relationships between the Characteristics and the Factors of SQ3

SQ3	Stakeholder		Gender		Age		Occupation		Income		Frequency		Payment	
	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p
SQ3_1	2.317	.128	1.859	.395	3.141	.370	6.775	.050	13.770	**.003****	2.083	.149	0.031	.861
SQ3_2	.069	.792	2.046	.360	.337	.953	10.925	**.027***	5.499	.139	0.006	.936	3.889	**.049***
SQ3_3	.485	.486	3.184	.204	1.820	.611	17.998	**<.001***	16.110	**.001****	0.031	.860	3.374	.066
SQ3_4	5.128	**.024***	1.812	.404	10.841	.630	5.925	.065	4.817	.186	0.052	.820	4.663	**.031***
SQ3_5	1.214	.271	12.086	.052	.289	.962	15.766	**.002***	4.538	.209	1.815	.178	8.338	**.004****
SQ3_6	.074	.786	2.765	.251	1.543	.672	4.697	.195	2.585	.460	1.782	.182	2.233	.135

*Note: *Significant at 0.05 Significance Level; **Significant at 0.01 Significance Level*

Table 6.17: The Relationships between the Characteristics and the Factors of SA

SA	Stakeholder		Gender		Age		Occupation		Income		Frequency		Payment	
	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p	χ^2	p
SA1	13.290	**<.001****	2.194	.334	3.319	.345	14.009	**0.004****	5.989	0.112	0.676	0.411	2.768	0.096
SA2	8.130	**.004****	1.558	.459	1.848	.605	14.252	**0.006****	5.495	0.139	0.435	0.510	8.631	**0.003****
SA3	.002	.963	4.742	.093	.750	.861	11.091	**0.101**	6.211	0.102	1.284	0.257	3.142	0.076
SA4	13.896	**<.001****	2.148	.342	.817	.845	15.070	**0.004****	3.225	0.358	0.003	0.958	5.008	**0.025***

*Note: *Significant at 0.05 Significance Level; **Significant at 0.01 Significance Level*

Table 6.18: The Relationships between the Characteristics and the Factors of PV

PV	Stakeholder		Gender		Age		Occupation		Income		Frequency		Payment	
	χ^2	p	χ^2	p	χ^2	p	χ^2	χ^2	p	χ^2	p	χ^2	p	χ^2
PV1	8.411	**.004****	1.572	.456	.671	.880	16.246	**0.002****	2.273	0.518	0.929	0.335	2.119	0.145
PV2	11.284	**.001****	2.119	.347	2.470	.481	6.606	0.106	1.458	0.692	2.915	0.088	13.821	**0.000****
PV3	10.802	**.001****	3.702	.157	2.731	.435	13.788	**0.007****	2.033	0.566	0.383	0.536	7.703	**0.006****

*Note: *Significant at 0.05 Significance Level; **Significant at 0.01 Significance Level*

Table 6.19: The Relationships between the Characteristics and the Factors of BI

BI	Stakeholder		Gender		Age		Occupation		Income		Frequency		Payment	
	χ^2	p	χ^2	p	χ^2	p	χ^2	χ^2	p	χ^2	p	χ^2	p	χ^2
BI1	21.836	<.001**	1.223	.542	4.839	.184	13.194	0.100	4.046	0.256	2.454	0.117	9.533	0.002**
BI2	22.190	<.001**	3.632	.163	.482	.923	12.395	0.013*	0.098	0.992	1.894	0.169	10.343	0.001**
BI3	6.141	.013*	2.937	.230	.741	.864	11.649	0.015*	7.103	0.069	0.010	0.919	0.841	0.359

*Note: *Significant at 0.05 Significance Level; **Significant at 0.01 Significance Level*

In conclusion, from Tables 6.11 to 6.19, it can be seen that not every result of the tests in each of the SQ, SA, PV, and BI factors is significant, either at 0.05 or at 0.01 the levels of significance. Several results in the study are **ineffective** from the personal information details in the questionnaire survey form to the levels of perceived satisfaction.

The information details are categorised by the significant characteristics of “gender”, “frequency of use”, and “age” and analysed by the Equal Variance and Mean Different Tests as explicated in the Tables 6.11 to 6.13. Similarly, the characteristics of gender, age, and frequency are also cross-examined by the Kruskal-Wallis Chi-square Test as well as elucidated in the Tables 6.14 to 6.19 sequentially.

In other words, no matter what the characterised variables including gender, age, and frequency are, they do not influence any level of perceived satisfaction in the factors SQ, SA, PV, and BI.

6.8 Modelling User Satisfaction in the EXAT projects

In order to model the relationships between the users and officials as the major groups of EXAT Stakeholders, the statistical tests continue to be adapted and applied from the results to explicate in this section. These outcomes of the interrelated impact of "Stakeholder" on the factors SQ, SA, PV, and BI have already been analysed by the Kruskal-Wallis Chi-square Test as well as explained in the Tables 6.14 to 6.19. The "Significance Level" is significant at 0.01 (or sometimes 0.05 for a field study or survey). This is also associated with the statistical testing (p-value or "p") of the differences between two or more groups.

It is also the case that Mann-Whitney U Test can be employed with two independent samples if the data are at least ordinal; it is an alternative to the t-test without the latter's limiting assumptions. In terms of computing the Mann-Whitney U Test, all observations are taken in a combined approach and ranked, algebraically, from smallest to largest. The largest negative score receives the lowest rank. In cases of ties, the average rank is assigned as in other tests. With this test, the samples can also be tested that are unequal. After ranking the values of variables, the ranked values for each sample are totalled.

When considering the results from the Tables 6.20 to 6.25, it is notable that in each factor (from SQ to BI), every computed value of **the Perceived Satisfaction Mean Rank** for the EXAT officials is considerably higher than for that of the EXAT users.

Obviously, these outcomes clarify that the average (mean rank) of the Perceived Satisfaction of officials is significantly higher than for that of the Perceived Satisfaction of users in every factor which are the same results as displayed in Table 6.10: Levels of Satisfaction between the Users and Officials in Each Factor.

This means that the corporate goals of the officials are that they are always eager to serve their users with ultimate quality services in forms of SQ, SA, PV, and BI.

Table 6.20: The Perceived Satisfaction in the Factors of SQ1

SQ1	Major EXAT Stakeholders	Count	Perceived Satisfaction					
			Mean Rank	1	2	3	4	5
SQ1_3	Users	561	299.57	2	26	148	274	111
				0.4%	4.6%	26.4%	48.8%	19.8%
	Officials	52	387.16	0	1	6	24	21
				.0%	1.9%	11.5%	46.2%	40.4%
SQ1_4	Users	561	301.40	29	66	216	195	55
				5.2%	11.8%	38.5%	34.8%	9.8%
	Officials	52	367.37	0	2	18	25	7
				.0%	3.8%	34.6%	48.1%	13.5%
SQ1_5	Users	561	302.18	6	38	177	259	81
				1.1%	6.8%	31.6%	46.2%	14.4%
	Officials	52	359.02	0	2	13	22	15
				.0%	3.8%	25.0%	42.3%	28.8%
SQ1_6	Users	561	299.78	3	27	172	262	97
				.5%	4.8%	30.7%	46.7%	17.3%
	Officials	52	384.89	0	1	9	22	20
				.0%	1.9%	17.3%	42.3%	38.5%

Table 6.21: The Perceived Satisfaction in the Factors of SQ2

SQ2	Major EXAT Stakeholders	Count	Perceived Satisfaction					
			Mean Rank	1	2	3	4	5
SQ2_1	Users	561	300.33	1	26	174	265	95
				.2%	4.6%	31.0%	47.2%	16.9%
	Officials	52	378.93	0	1	8	26	17
				.0%	1.9%	15.4%	50.0%	32.7%
SQ2_3	Users	561	302.05	4	31	189	264	73
				.7%	5.5%	33.7%	47.1%	13.0%
	Officials	52	360.41	0	1	14	23	14
				.0%	1.9%	26.9%	44.2%	26.9%
SQ2_4	Users	561	301.89	7	49	213	219	73
				1.2%	8.7%	38.0%	39.0%	13.0%
	Officials	52	362.15	0	4	12	24	12
				.0%	7.7%	23.1%	46.2%	23.1%
SQ2_5	Users	561	302.43	4	40	188	257	72
				.7%	7.1%	33.5%	45.8%	12.8%
	Officials	52	356.25	0	3	13	22	14
				.0%	5.8%	25.0%	42.3%	26.9%
SQ2_6	Users	561	301.20	3	27	175	267	89
				.5%	4.8%	31.2%	47.6%	15.9%
	Officials	52	369.60	0	0	11	26	15
				.0%	.0%	21.2%	50.0%	28.8%

Table 6.22: The Perceived Satisfaction in the Factors of SQ3

SQ3	Major EXAT Stakeholders	Count	Perceived Satisfaction					
			Mean Rank	1	2	3	4	5
SQ3_4	Users	561	302.42	3	23	143	268	124
				.5%	4.1%	25.5%	47.8%	22.1%
	Officials	52	356.41	0	1	8	26	17
				.0%	1.9%	15.4%	50.0%	32.7%

Table 6.23: The Perceived Satisfaction in the Factors of PV

PV	Major EXAT Stakeholders	Count	Perceived Satisfaction					
			Mean Rank	1	2	3	4	5
PV1	Users	561	301.14	10	52	187	257	55
				1.8%	9.3%	33.3%	45.8%	9.8%
	Officials	52	370.20	0	1	12	31	8
				.0%	1.9%	23.1%	59.6%	15.4%
PV2	Users	561	300.25	6	23	149	279	104
				1.1%	4.1%	26.6%	49.7%	18.5%
	Officials	52	379.83	0	1	6	27	18
				.0%	1.9%	11.5%	51.9%	34.6%
PV3	Users	561	300.36	6	33	178	262	82
				1.1%	5.9%	31.7%	46.7%	14.6%
	Officials	52	378.67	0	2	7	29	14
				.0%	3.8%	13.5%	55.8%	26.9%

Table 6.24: The Perceived Satisfaction in the Factors of SA

SA	Major EXAT Stakeholders	Count	Perceived Satisfaction					
			Mean Rank	1	2	3	4	5
SA1	Users	561	299.41	2	17	168	314	60
				.4%	3.0%	29.9%	56.0%	10.7%
	Officials	52	382.85	0	0	8	30	14
				.0%	.0%	15.4%	57.7%	26.9%
SA2	Users	561	299.41	2	18	202	293	46
				.4%	3.2%	36.0%	52.2%	8.2%
	Officials	52	364.87	0	1	11	30	10
				.0%	1.9%	21.2%	57.7%	19.2%
SA4	Users	561	299.74	10	23	199	278	51
				1.8%	4.1%	35.5%	49.6%	9.1%
	Officials	52	385.31	1	4	16	26	5
				1.9%	7.7%	30.8%	50.0%	9.6%

Table 6.25: The Perceived Satisfaction in the Factors of BI

BI	Major EXAT Stakeholders	Count	Perceived Satisfaction					
			Mean rank	Very dissatisfied	dissatisfied	average	satisfied	Very satisfied
BI1	Users	561	297.66	2	29	150	292	88
				.4%	5.2%	26.7%	52.0%	15.7%
	Officials	52	407.79	0	0	7	22	23
				.0%	.0%	13.5%	42.3%	44.2%
BI2	Users	561	297.40	5	32	184	249	91
				.9%	5.7%	32.8%	44.4%	16.2%
	Officials	52	410.62	0	0	8	22	22
				.0%	.0%	15.4%	42.3%	42.3%
BI3	Users	561	301.82	53	104	188	175	41
				9.4%	18.5%	33.5%	31.2%	7.3%
	Officials	52	362.92	2	4	20	19	7
				3.8%	7.7%	38.5%	36.5%	13.5%

6.9 Chapter Summary

As already mentioned, this chapter explicates the comprehensive analysis and discussion of research findings from data collection through the questionnaire survey. Then, the collected data have been analysed by the statistical software packages. Microsoft Excel and Statistical Package for the Social Sciences (SPSS) have been employed to analyse the data. The comparison between the outcomes of the research and the proposed aim and objectives has been achieved.

The 561 EXAT *Users* and 52 EXAT *officials* from this questionnaire survey as part of the quantitative approach are satisfied with the EXAT facilities. The A4 questionnaire was designed as a five-point Likert scale ranging from "High Level of Satisfaction (5) to Low Level of Satisfaction (1)" for ease of rating. The statistical findings of the **user** and **official** perceived satisfaction are summarised as presented in the **two major groups** of the **EXAT stakeholders**.

User Perceived Satisfaction

The levels of the satisfaction with the EXAT services in each factor are listed below:

SQ is between 3.61 and 3.74, and the average is (3.74+3.67+ 3.61)/3 = 3.67;

SA is between 3.60 and 3.74, and the average is (3.74+3.65+ 3.60+3.65)/4 = 3.66;

PV is between 3.53 and 3.81, and the average is (3.53+3.81+ 3.68)/3 = 3.67;

BI is between 3.08 and 3.78, and the average is (3.78+3.69+ 3.08)/3 = 3.52.

Official Perceived Satisfaction

The levels of the satisfaction with the EXAT services in each factor are noted below:
SQ is between 3.63 and 4.05, and the average is (4.05+3.96+ 3.63)/3 = 3.88;
SA is between 3.58 and 4.12, and the average is (4.12+3.94+ 3.58+4.04)/4 = 3.92;
PV is between 3.88 and 4.19, and the average is (3.88+4.19+ 4.06)/3 = 4.04;
BI is between 3.48 and 4.31, and the average is (4.31+4.27+ 3.48)/3 = 4.02.

The findings derived from this chapter are now available as variables to construct the framework model. In this research study, the responses to questions were analysed using various statistical methods consisting of ANalysis Of Variance (ANOVA), Levene's Test, Kruskal-Wallis Test, and Mann-Whitney U Test. The analyses of descriptive statistics such as Mean and Standard Deviation (SD) have been selected to support the research questions, aim, and objectives. These are significant and relative to the perceived satisfaction of the EXAT users and officials. The Chi-square (χ^2) test was also required to determine the relationship between characteristics of the EXAT respondents and the factors (i.e. service, safety, operation, and other factors) in the questionnaire.

As reported by the characteristics of "gender", "frequency of use", and "age", each result of the tests of both "Equal Variance" and "Mean Different" in all SQ, SA, PV, and BI factors is not significant either at 0.05 or at 0.01 Significance Levels.

In this research study, the **key stakeholders** were EXAT **users** and **officials**. Their key characteristics were gender, age, occupation, income, frequency of use, and payment method. EXAT respondents have not had the correlated impact of "Gender", "Age", and "Frequency" on the tests (Kruskal-Wallis Test, and Mann-Whitney U Test) since all of them have not been significant at any level. These are also elucidated in Tables 6.14 to 6.19.

In other words, no matter what the classification variables including gender, age, and frequency of use are, they do not influence any level of perceived satisfaction in the factors SQ, SA, PV, and BI. This means that the **three variables** "Gender, Age, and Frequency" of use **have no effect** on the levels of perceived satisfaction.

CHAPTER SEVEN
STRUCTURAL EQUATION MODELLING

7.1 Introduction

The preceding chapter has already reported all the consequences of the questionnaire to Expressway Authority of Thailand (EXAT) **users** and **officials** who are **key stakeholders**.

This chapter presents the study, analysis and outcomes of the Structural Equation Modelling (SEM) by modelling, analysing, verifying, and validating the model. As a consequence, this chapter obtains a deeper understanding of SEM in terms of modelling. After modelling and analysing the research model using the SEM programme, LInear Structural RELationships (LISREL) was utilised to verify the research model. In order to acquire a valid/base model, the model should be legally or officially accepted by the policy as prescribed by the experts in the field. These experts all agree that this model is both valid and beneficial for improving the understanding of User Satisfaction (US) with PPP projects with a view to **improved Customer Satisfaction** (CS).

7.2 The Consequences Relating to Expectation Criteria

This chapter introduces of the approaches of SEM which explicates the SEM including other technical issues involved during the interview sections. The statistically advanced technique adapted for data collection and analysis is also outlined. A description of selected stakeholders follows before a discussion of the interview findings. A cross analysis of the findings of the key stakeholders, along with their answers to the questionnaire survey is presented. Finally, the key findings are restated.

Furthermore, the quantitative research methods have been conducted in order to measure and model the perceived satisfaction of EXAT users and officials. The results relate to the expectation criteria which the users perceive the EXAT facilities to be. These include Service Quality (SQ), Perceived Value (PV), Satisfaction (SA), and Behaviour Intentions (BI). Correspondingly, the qualitative approaches have also been employed as part of research designs to qualify a verified and validated model as a valid model (base model).

Thus, the model can identify and evaluate the benefits associated with PPP projects in Thailand and/or other developing countries (Cronin *et al.*, 2000; Kotler, 2002; Tangkitsiri and Ogunlana, 2004; Kotler and Keller, 2006; Olorunniwo *et al.*, 2006; Chen, 2008; Hair *et al*., 2010; Schumacker and Lomax, 2010; Lai and Chen, 2011; Lai and Chen, 2011; and Tangkitsiri *et al.*, 2013b).

7.3 The Technique of Structural Equation Modelling (SEM)

As already mentioned in Chapter Four (Research Design and Methodology), Structural Equation Modelling (SEM) is advanced statistics which is part of the statistical method series. It has become popular among the social sciences research methods in recent years (Cuttance and Ecob, 1987; Byrne, 1998; Maruyama, 1998; Byrne, 2001; Schumacker and Lomax, 2004; Byrne, 2010; Schumacker and Lomax, 2010; and Byrne, 2012).

In accordance with Hair *et al*. (2010), Structural equation modelling (SEM) is a family of statistical models assisting to explicate the relationships among multiple variables. This means that SEM technique examines a **Structural** set of interrelationships expressed in a series of **Equation**s and illustrates a diagram with **Modelling**. That is why this approach is called **"Structural Equation Modelling"** and its acronym is **SEM**. This statistical model is similar to a series of multiple regression equations. In addition, the analysis equations present all of the relationships among the dependent and independent variables involved in the structure of its analysis model. The relationships are unobservable or latent factors.

Moreover, it is referred to as "Factors" represented by multiple variables which are the same as variables representing a factor in factor analysis. SEM has also been mentioned as the unique combination of both types of the techniques composed of interdependent or dependent techniques since the foundation of SEM has lain in two familiar multivariate techniques, these are factor analysis and multiple regression analysis. This refers to the conclusion found by Cooper and Schindler (2014) that Structural Equation Modelling (SEM) employed analysis of covariance structures to explicate causality among constructs.

Byrne (1998; 2001; 2010; and 2012) and Schumacker and Lomax (2004; and 2010) mentioned that not only is SEM designed to examine a conceptual, theoretical or

hypothetical model, but it is also a well-balanced combination between the two lines of methodological and statistical development in the social and behavioural sciences. This means that this advanced numerical method allows the evaluation of both the direct and indirect relationships among all of the latent variables (Factors). In addition, this high level of statistical technique allows complex relationships between one or more observed variables (Indicators) and one or more latent variables (Factors).

In other words, complex statistics may be more readily understood by modelling the structural equation and combination of the two groups of variables. That is between a **measurement model** referring to the latent variables (Factors) employing one or more observed variables (Indicators) and a **structural** regression **model** (or a structural model) linking all the latent variables (Factors) together. This is comprised of modelling in forms of SEM including Confirmatory Factor Analysis (CFA), path analysis, and latent growth modelling (Cuttance and Ecob, 1987; Byrne, 1998; Maruyama, 1998; Byrne, 2001; Schumacker and Lomax, 2004; Byrne, 2010; Schumacker and Lomax, 2010; and Byrne, 2012).

Hair *et al*. (2010) reviewed key terms to develop a clarified understanding of the SEM method and its terminology. The key terms could also be applied to generate a particular methodical approach in terms of SEM and the subject of its study. The words of the key terms are in **bold font**. The other points of emphasis in the SEM research and cross-referred key terms are in *italics*. These are described as mentioned in Appendix E.

In conclusion, Structural Equation Modelling (SEM) is one of the statistical theory family models. The SEM model is developed and analysed as the advanced statistical method. It is also been designed to test a hypothetical or conceptual model. The SEM technique is comprised of Confirmatory Factor Analysis (CFA), latent growth modelling, and path analysis. Furthermore, this SEM approach is recognised by other names such as latent variable analysis or covariance structure analysis. Sometimes it is even referred to by the name of the specialised analysis software packages employed such as LISREL, AMOS and Mplus (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al*., 2010; Schumacker and Lomax, 2010; and Byrne, 2012).

Furthermore, Hair *et al*. (2010) stated that SEM models can be examined and analysed in different ways, yet all of the Structural Equation Models share the three following characteristics:

1. Estimation of multiple and interrelated dependence relationships;
2. An ability to represent unobserved concepts in these relationships and account for measurement error in the estimation process;
3. Defining a model to explicate the entire set of relationships.

7.4 The Validity and Reliability of Modelling

Validity and reliability have both been described in the key term review already. It is, however, essential to understand them comprehensively in order to generate a particular methodical approach in terms of SEM and a subject of its relevant study. In order for research data to be of value and use, the model must be both valid and reliable (comparative ease of use by the researchers and organisations). This means that a hypothesised classification of the categorical variables has been established and developed since both of the key literature review and significant resolution factors have been reached and determined after consideration.

A pilot test has been conducted after the questionnaire of user satisfaction had been completed (Level of Satisfaction with the EXAT services). The questionnaire was reviewed after consultation with specialists. This is called “Index of Item-Objective Congruence or Item-Objective Congruence Index and its acronym is IOC (Rovinelli and Hambleton, 1977; and Turner, R.C., and Carlson, L. 2002).

In order to meet the content validity, the questionnaire must be reviewed by experts rating items of the content regarding how well they accomplish the aim and/or objectives of the designed questionnaire. That is, content validity is established to the degree to which the content of the questionnaire is legally or officially acceptable (Saunders *et al.,* 2009; Bryman, 2012; Cooper and Schindler, 2014; and Creswell, 2014).

As already defined in Chapter Four (Research Design and Methodology), the word “Validity” is “the state of being legally or officially acceptable” and/or “the state of being logical and true”. Also, validity refers to the credibility or believability of the SEM

research. Validity refers to the extent to which something (e.g. an approach, process, or outcome) is logical and true (Hair *et al*., 2010; The Oxford Advanced Learner's Dictionary, 2016).

Similarly, "Reliability: is the quality of being likely to be correct or true; moreover, it may refer to the repeatability of findings (The Oxford Advanced Learner's Dictionary, 2016). Hair *et al*. (2010) commented that "Reliability" is the measure of the degree to which a set of *indicators* of a *latent construct* internally relies on their measurements. The indicators of highly consistent *constructs* are closely connected and affect each other. This can be the indication that all of them appear to measure the same thing. The individual item reliability can be calculated as 1.0 minus the *measurement error*.

This SEM research study is accomplished to operationalise the construct through the development of scales to measure the construct. According to the designed conceptual framework, this thesis composes the modelling variables in the SEM research framework as represented in the section on "Study of the Conceptual Framework of the Research Model" in Chapter Four. A series of the expert interviews confirm the five principal dimensions of the "Multiple-Item Scale" for measuring user perceptions.

These are: Service Quality (SQ), Perceived Value (PV), Satisfaction (SA), and Behaviour Intentions (BI). The details of these have been described in Table 2.1: Service Quality (SQ) Scale Dimensions for Customers/Users and Table 5.3: Links between Service Quality (SQ) Factors and Scale Dimensions. Finally, a generated SEM framework is researched, built, and modelled. The model is outlined and depicted in Figure 5.2 (Proposed hypothetical model of Perceived Satisfaction of EXAT Users).

Each item for measuring these dimensions is generated through the previous research articles and studies. This research study is conducted and developed through the pilot study before collecting and analysing the questionnaire survey data. The sample of 561 EXAT user respondents is implemented for the analysis. By means of the Confirmatory Factor Analysis (CFA), this SEM research is able to affirm the reliability and validity of the Measurement model. Finally, the outcomes of the SEM study affirm the dimensions of SQ. The identified dimensions are: Services, Safety, and Operation Factors.

7.5 Confirmatory Factor Analysis

According to APA (1974), Construct validity is one of the three categories of validity as mentioned below:

1. **Content validity**, i.e. logical validity, deals with subject-matter content testing. Surveys of panels of content experts or focus groups of representative subjects are approaches in which the content validity may be established even if applying subjective findings.

2. **Construct validity**, i.e. factorial validity, deals with the logic of items that comprise measures of social concepts. A good construct has a hypothetical basis which is translated through clear operational definitions involving measurable indicators.

3. **Criterion validity**, i.e. concurrent validity deals with the correlation between scale or instrument measurement items and known and accepted standard measures or criteria.

As previously mentioned, there are only two types of validity which are implemented in this study research. The first is content validity described in Chapter Four. The second is **Construct Validity** explained in the section **Confirmatory Factor Analysis (6.4)**, and its acronym is **CFA** (Fornell and Larcker, 1981; Hair *et al.*, 2010; Schumacker and Lomax, 2010; and Sreejesh and Mohapatra, 2014).

Next, Hair *et al.*, 2010 stated that when CFA results are combined with construct validity tests, researchers can obtain a better understanding of the quality of their measures. It is also cited that validity is defined as the extent to which research is accurate. CFA eliminates the need to accumulation scales since the SEM programme analyses latent construct scores for each respondent. This process allows relationships between constructs to be automatically corrected for the amount of error variance that exists in the construct measures. Construct validity is the extent to which a set of measured items actually reflects the theoretical latent construct those items are designed to measure. Thus, it deals with the accuracy of measurement. Evidence of construct validity provides

confidence that item measures taken from a sample represent the actual true score that exists in the population.

In other words, CFA is the use of a multivariate technique to affirm or test a pre-specified relationship. If a factor is analytically tested for the significance of these two predictors and the non-significance of all others, this factor will be a confirmatory analysis (Fornell and Larcker, 1981; Hair *et al.*, 2010; Schumacker and Lomax, 2010; and Sreejesh and Mohapatra, 2014).

It is also quoted that the items that are indicators of a specific construct should converge or share a high proportion of variance in common. This is recognised as **Convergent Validity**. Several ways are available to estimate the relative amount of convergent validity among item measures including Factor Loading and Construct Reliability (Hair *et al*., 2010).

Similarly, the size of the **"Factor Loading"** is one important consideration. In terms of high convergent validity, high loadings on a factor would indicate that they converge on a common point, the latent construct. At a minimum, all factor loadings should be statistically significant. Commonly, standardised loading estimates should be 0.5 or higher and ideally 0.7 or higher (Hair *et al*., 2010; and Schumacker and Lomax, 2010).

"Reliability" is also an indicator of convergent validity. Divergent reliability coefficients do not construct or composite dramatically different reliability estimates.

Construct Reliability or Composite Reliability (CR) value is frequently implemented in conjunction with SEM models. It is analysed from the squared sum of factor loadings for each construct and the sum of the error variance terms for a construct. The rule of thumb for reliability is a result of 0.7, or higher, suggests good reliability, and the closer to 1.0 is the most reliable (Fornell and Larcker, 1981; Hair *et al.*, 2010).

The research demonstrates the Construct Validity and Reliability as well as the appropriateness of the SEM model in terms of measuring the Factors or Latent Variables. This thesis has examined the construct validity/reliability with Convergent Validity. This can be called a **"Measurement Model"**. Additionally, this represents Goodness-Of-Fit

(GOF) and the covariance between each question in the EXAT questionnaire (Fornell and Larcker, 1981; Hair *et al.*, 2010; and Sreejesh and Mohapatra, 2014).

Hair *et al.* (2010) and Schumacker and Lomax (2010) supported the idea utilised in this thesis that CFA output includes fit indices. Not every possible fit index is presented, yet it is essential to focus on the major GOF values using the aforementioned guidance for reliability to provide assessment of fit. Each SEM programme (e.g. AMOS or LISREL) includes a slightly different set. They all, however, contain the key values such as the Chi-square (χ^2) statistic, Normed Fit Index (NFI), Relative Fit Index (RFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). This means that the principally focused fit indices are analysed, and they offer knowledge of the null model Chi-square (χ^2). In other words, the null model can be called independence model where the covariance terms are assumed to be zero in the model, null model *df*, hypothesised model χ^2, hypothesised model *df*, number of observed variables in the model, number of free parameters in the model, and sample size.

The formula for the Normed Fit Index (NFI), the Relative Fit Index (RFI), the Comparative Fit Index (CFI), and the RMSEA implementing these values are as follows:

$$NFI = (\chi^2_{null} - \chi^2_{model}) / \chi^2_{null}$$

$$RFI = 1 - [(\chi^2_{model} / df_{model}) / (\chi^2_{null} / df_{null})]$$

$$CFI = 1 - [(\chi^2_{model} - df_{model}) / (\chi^2_{null} - df_{null})]$$

$$RMSEA = \sqrt{[\chi^2_{model} - df_{model}]/[(N-1)df_{model}}$$

Fornell and Larcker (1981), Hair *et al.* (2010), Schumacker and Lomax (2010), and Kuo and Tang (2013) concluded and included the statistical significance of the results supporting and relevant to CFA Models as displayed in Table 7.1: CFA Model for Perceived SQ and Table 7.2: CFA Model for PV, SA, and BI. These results are based on the "Model Fit" in terms of criteria for model selection. The values of NFI, RFI, and CFI above 0.90 are usually associated with a model that fits well.

An empirical examination of several measures discover that the **R**oot **M**ean **S**quare **E**rror of **A**pproximation (RMSEA) was best suited to employ in a confirmatory or competing

models strategy as samples become larger. Large samples can be considered as consisting of more than 500 respondents (e.g. 561 EXAT user respondents in this research study). There is a significant advantage to RMSEA which a confidence interval can be constructed contributing the range of RMSEA values for a given level of confidence. It would be better if the RMSEA was between 0.03 and 0.05 (Hair *et al.*, 2010).

Finally, according to Fornell and Larcker (1981), Hair *et al.* (2010), Schumacker and Lomax (2010), and Kuo and Tang (2013), the outcomes of this research study are compared with the model fit criteria for the model selection. The consequences are also presented in Table 7.1 (CFA Model for Perceived SQ) and Table 7.2 (CFA Model for PV, SA, and BI). These include the convergent validity of the measurement model and can be determined as the statistically significant test which is composed of

(i) Standardised Loading (SL) and p-value = 0.5 or higher;

(ii) t-value : t = 2.58 or higher *Significant at 0.01 Significance Level;

(iii) Composite or Construct Reliability (CR) = between 0.7 and 1.0* the closer to 1.0 is the most reliable;

(iv) Chi-square/df = lower than 3.0;

(v) NFI = between 0 and 1* the closer to 1.0 is best;

(vi) RFI = between 0 and 1* notably the closer to 1.0 is best;

(vii) CFI = between 0 and 1* notably the closer to 1.0 is best;

(viii) RMSEA = between 0.03 and 0.08; it is best if the RMSEA is between 0.03 and 0.05.

Table 7.1: CFA Model for Perceived SQ

SQ	Perceived Service Quality Factors	SD	t-value	CR
SQ1	***Service Factors***			0.807
SQ1_1	The convenience of using the expressway	0.641a	---	
SQ1_2	Quickness in passing through the pay stations	0.574	12.808	
SQ1_3	Short travel time on expressways relative to other routes	0.596	12.168	
SQ1_4	Appropriate Fare	0.688	13.682	
SQ1_5	Good feeling using expressways (emergency phones at every 1 KM)	0.700	13.844	
SQ1_6	Confidence in using the expressway due to free accident services	0.644	12.943	
SQ2	***Safety Factors***			0.881
SQ2_1	Confidence due to CCTV monitoring traffic conditions and incidents	0.693a	---	
SQ2_2	The sufficiency of traffic signs to display traffic signals	0.715	16.899	
SQ2_3	The clarity of traffic signs to display traffic signals	0.742	16.195	
SQ2_4	The safety of junctions on expressways	0.789	17.186	
SQ2_5	The safety of expressway ramps connecting to non-express roads	0.743	16.302	
SQ2_6	Feeling of safety whilst driving on the expressways	0.773	16.793	
SQ3	***Operation Factors***			0.861
SQ3_1	Sufficient networking of expressways	0.594a	---	
SQ3_2	Efficiency of toll collection systems (including Easy Pass)	0.736	15.049	
SQ3_3	Traffic management	0.805	14.472	
SQ3_4	The cleanliness of expressways	0.634	12.291	
SQ3_5	The predictability of travel time	0.793	14.360	
SQ3_6	Beneficial Information (traffic conditions; significant events) through VMS	0.698	13.203	
Note:	*a = fixed parameter; Chi –square = 149.135, df = 130, p-value = 0.120, Chi-square/df = 1.147, NFI = 0.992, RFI = 0.990, CFI = 0.999, RMSEA =0 .316*	Chi-square/df < 3.0 0.9 > NFI; RFI; CFI > 1.0* 0.03 > RMSEA > 0.05		

Adopted from Appendix D: The Final CFA Models of SQ, PV, SA, and BI

Table 7.2: CFA Model for PV, SA, and BI

Factors	Latent Variables	SD	t-value	CR
PV	**Perceived Value**			0.831
PV1	Value for money	0.790a	-	
PV2	Saving travel time	0.779	19.898	
PV3	Improving the quality of the traveller's life	0.799	20.524	
SA	**Satisfaction**			0.793
SA1	Overall Satisfaction with Service Factors	0.626a	-	
SA2	Overall Satisfaction with Safety Factors	0.632	14.148	
SA3	Overall Satisfaction with Operation Factors	0.742	16.056	
SA4	Overall Satisfaction with expressways	0.897	16.812	
BI	**Behavioural Intentions**			0.826
BI1	Willingness to use the expressways frequently	0.727a	-	
BI2	Willingness to recommend the EXAT (facilities) to others	0.757	22.914	
BI3	Willingness to travel despite fare increases	0.651	15.145	
Note:	*a = fixed parameter; Chi –square = 41.745, df = 32 , p-value = 0.116, Chi –square /df = 1.739, NFI = 0.995, RFI = 0.993, CFI = 0.999, RMSEA = 0.023*	Chi-square/df < 3.0 0.9 > NFI; RFI; CFI > 1.0* 0.03 > RMSEA > 0.05		

Adopted from Appendix D: The Final CFA Models of SQ, PV, SA, and BI

7.6 Model Verification and Validation through the Quantitative Research Study

This part is from the continuation of the section research methodology discussed in the section 5.2 (Constructing a Model to Determine the Extent of Perceived Satisfaction), wherein the research discusses the qualitative methodology for model conceptualisation implementing the philosophical approach of the SEM Research Framework and Hypotheses. Hence, this continues to the quantitative approach which aimed to verify and validate the test of the proposed conceptual model statistics. As the study follows the

mixed methods of qualitative and quantitative approaches and these two interconnected methodologies are utilised.

While computing the data to acquire the SEM results of the model validation and testing through the quantitative research strategy, the qualitative stage identified the dimensional factors of SQ, PV, SA, and BI of EXAT users. After investigating these dimensions, the SEM technique developed schemes through linking between Service Quality (SQ) Factors and Scale Dimensions. For operationalising these dimensions, the integrated research adapted and applied the measures from the relevant literature reviewed. These reviews include the nine academic journal articles which are relevant and crucial to this study. These are also exemplified in Table 5.1 (Modelling Variables in the SEM Research Framework). Five of these academic article studies state that BI is the critical regulating variable which implicitly impacts on "customer loyalty" through such Service Quality (SQ) factors as Perceived Value (PV) and Customer Satisfaction (CS).

Descriptive Analysis

561 EXAT drivers from the quantitative approach are satisfied with the EXAT facilities. This concise questionnaire is designed as a five-point Likert scale ranging from "High Level of Satisfaction (5) to Low Level of Satisfaction (1)" for ease of rating (Likert, 1932; Tangkitsiri and Ogunlana, 2004; Armitage and Conner, 2001; and Norman, 2010).

The four major factors SQ, PV, SA, and BI are measured by the level of perceived satisfaction via the questionnaire, and these factors are analysed by the statistical programmes, i.e. (i) Microsoft Excel and (ii) Statistical Package for the Social Sciences (SPSS) for the Descriptive Analysis as well as (iii) Linear Structural RELationships (LISREL) for the SEM model.

From the descriptive analysis in this study, it is discovered that the mean scores for the perceived satisfaction of SQ, PV, SA, and BI are 3.67, 3.67, 3.66, and 3.52 respectively. Additionally, the correlation analysis of each variable of SQ, PV, SA, and BI is performed accommodating a matrix of the correlation coefficients followed by extraction of the loadings and values of the correlation matrix as described in Table 7.3 (The Matrix of Mean, Standard Deviation, and Correlation).

Correlation coefficient (***r***) indicates the strength of the association between any two metric variables. The sign (+ or -) determines the direction of the relationship. The value is able to range from + 1 to -1, with + 1 indicating a perfect positive relationship, 0 indicating no relationship, and -1 indicating a perfect negative or reverse relationship such as a variable is larger whilst the other variable is smaller (Hair *et al*., 2010; and Schumacker and Lomax, 2010).

Correspondingly, when considering the coefficient of correlation (correlation coefficient), this research study reveals the relationship between the four variables and all of the variables are identified and associated. In addition, the values of correlation coefficient (***r***) are between 0.707 and 0.906 which are nearby + 1 indicating the perfect positive relationship. Table 7.3 discloses the descriptive analysis values of the matrix of mean, standard deviation, and correlation.

Table 7.3: The Matrix of Means, Standard Deviation, and Correlation

Factors	Mean	Standard Deviation	1. SQ	2. PV	3. SA	4. BI
1. Service Quality (SQ)	3.67	0.590	1			
2. Perceive value (PV)	3.67	0.724	0.906**	1		
3. Satisfaction (SA)	3.66	0.595	0.785**	0.799**	1	
4. Behavioural Intentions (BI)	3.52	0.756	0.707**	0.737**	0.776**	1
Note: High Level of Satisfaction (5); Low Level of Satisfaction (1); *All correlations are significant at 0.01 Significance Level by the 561 EXAT drivers*						

7.7 The Consequences of the SEM Hypotheses

According to Fornell and Larcker (1981), Hair *et al.* (2010), Schumacker and Lomax (2010), and Sreejesh and Mohapatra (2014) as well as the prior sections and chapters in cases of the statistically analysed results, the questionnaire survey responses from 561 EXAT users were obtained and analysed by Microsoft Excel, Statistical Package for Social Sciences (SPSS) for the descriptive analysis. In addition, Linear Structural

RELationships (LISREL) software is employed to compute the hypothesised User Satisfaction (US) model for modelling the structural equations. This permits an evaluation of both direct and indirect relationships among latent variables. The technique of SEM has been adapted and applied since it has been able to integrate the multiple dependent variables and fit in the exploratory concept, data, and model. The SEM approach involves multiple regressions, factor analysis, and path analysis. Hypothetically, this technique is built to determine and examine two categories of models, i.e. (i) a **measurement** model and (ii) a **structural** model.

Measurement models are already expressed in the Section 6.5 on Confirmatory Factor Analysis and in the Appendix D: Path Diagrams of the Final Models of SQ, PV, SA, and BI. The models measure the validity and reliability of the variables. In other words, the measurement model is the SEM model that (i) specifies the indicators for each construct and (ii) enables an assessment of construct validity.

The structural model mentioned previously is a set of one or more dependence relationships linking the hypothesised model's constructs. The structural model is most beneficial in representing the interrelationships of observed and/or unobserved variables between constructs. In other words, structural models simulate the relationships between the latent variables by mentioning the amount of explained and unexplained variance which asserts systems of simultaneous equation regression models.

Then, after affirming the factors (CFA) and measuring latent variable models (Measurement Model) in the research study, an approach of path analysis is computed to estimate the relationships in the model by means of estimating structural coefficients for testing hypotheses set. The path analysis technique can determine the strength of the paths represented in the path diagram constructed on the SEM framework and hypotheses (Hair *et al.*, 2010; Schumacker and Lomax, 2010; and Sreejesh and Mohapatra, 2014).

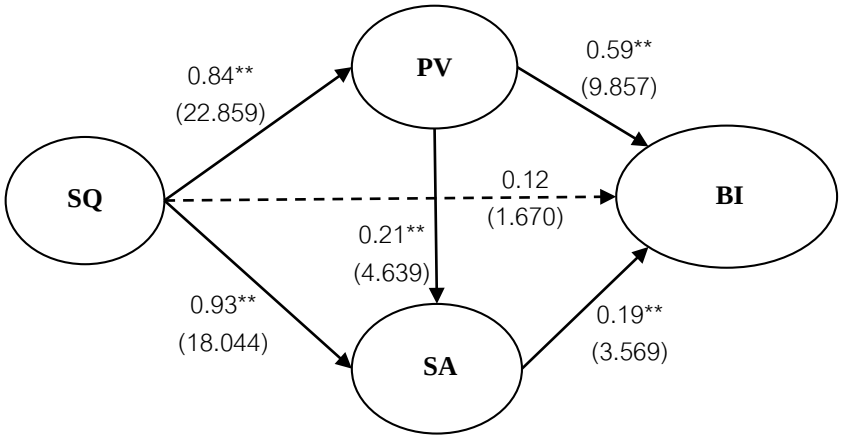
It is imperative to note that all loading path analysis of the measured attributes indicate significant loadings (significant at 0.01 level of significance) on their respective latent variables representing a perceived satisfaction level of individual variable reliability in the SEM. In other words, this is the visual representation of a hypothesised model and the complete set of the relationships among the constructs of the model. Dependence relationships are depicted by straight arrows, with the arrow deriving from the predictor

variable and the arrowhead pointing to the dependent construct or variable. Curved arrows represent correlations between constructs or indicators, yet no causation is implied (Hair *et al*., 2010; and Schumacker and Lomax, 2010). These analysed models are the so-called "Path Diagrams" as exemplified in Appendix D: Path Diagrams of the Final Models of SQ, PV, SA, and BI.

Lastly, the structural model in this research study is comprised of (i) the outside factor, i.e. ***exogenous construct***, which is the SQ factors and (ii) the three internal latent variables, i.e. ***endogenous constructs***, which are the PV, SA, and BI factors. The arrows lead into the endogenous constructs in terms of the path diagram with path analysis.

This structural model is adopted, analysed, and applied from the "SEM Research Framework and Hypotheses, Constructing a Model to Determine the Extent of Perceived Satisfaction" (section 5.2). These are elucidated in Figure 7.1 (Direct and indirect Effects of SQ, PV, SA, and BI) and Table 7.4 (The Summary of Testing of Hypotheses).

Furthermore, this structural model is adopted, analysed, and applied from the "SEM Research Framework and Hypotheses, Constructing a Model to Determine the Extent of Perceived Satisfaction".



***Significant at 0.01 Significance Level; t-value: t = 2.58 or higher*

Figure 7.1: Direct and indirect Effects of SQ, PV, SA, and BI

Adopted from the Figure 5.2: Proposed hypothetical model of Perceived Satisfaction of EXAT Users

Table 7.4: The Summary of Testing of Hypotheses

Hypothesis	Regression Weight	t-value	Result
H1: (SQ→PV)	0.84**	22.859	Supported
H2: (SQ→SA)	0.93**	18.044	Supported
H3: (SQ→BI)	0.12	1.670	Not Supported
H4: (PV→SA)	0.21**	4.639	Supported
H5: (PV→BI)	0.59**	9.857	Supported
H6: (SA→BI)	0.19**	3.569	Supported
*Note: **Significant at 0.01 Significance Level; t-value : t = 2.58 or higher, Chi –square = 11.189, df = 6 , p-value = 0.078, Chi –square/df = 1.864, NFI = 0.998, RFI = 0.994, CFI = 0.999, RMSEA = 0.04*			

Adopted from the Table 5.2: Summary of a Proposal of SEM Hypotheses

In summary, by means of Figure 7.1, Table 7.4, and Appendix D, it can hypothetically be discovered that this SEM model elucidates each hypothesised path. All of the analysed paths consist of the straight arrows deriving from the predictor or independent variable (with the arrowhead pointing) to the dependent constructs (variables) except from SQ to BI composed of the dotted arrow. The results are from path analysis to determine variables as direct and indirect effects of SQ, PV, SA, and BI on US. In other words, almost every path is supported by the results which are significant at 1% significance level; t-value is higher than 2.58, yet there is merely one path (H3) from SQ to BI not supported. This means that SQ is not able to lead to BI directly, yet it can occur at BI via either PV or SA. Table 7.5 exhibits the direct and indirect effects of SQ and PV on SA and BI in forms of "Regression Weight" developing from Table 7.4.

Table 7.5: Direct and Indirect Effects of SQ and PV on SA and BI

Predictor or Independent Variables	Factors (Latent Construct): Dependent Variables								
	PV			SA			BI		
	Direct	Indirect	total	Direct	Indirect	Total	Direct	Indirect	total
SQ	0.84	-	0.84	0.93	0.18	1.11	0.12	0.71	0.83
PV	-	-	-	0.21	-	0.21	0.59	0.04	0.63
SA	-	-	-	-	-	-	0.19	-	0.19

7.8 Model Verification and Validation through the Qualitative Research Study

In accordance with the former sections (6.7 and 6.6), the outcomes of the hypothesised model have been expounded and supported; however, the path (H3) from SQ to BI has not been supported yet. From the point of this research, it is crucial to determine whether this model is valid. In order to contribute a valid (base) model, this SEM model has to be verified and validated by the EXAT experts as part of a qualitative approach. By means of conducting the research to achieve a base model with its research aim and objectives, expert interviews are investigated to explore the strategy of the EXAT and its behaviour towards the levels of perceived satisfaction.

Likewise, in the marketing field, the qualitative approaches most frequently employed are (i) interviews and (ii) focus groups. These two techniques are extremely relevant to different research purposes, questions, aims, objectives, and types of data required. Interviews offer opportunities to attain sufficient and perceptive pieces of research information. The interviews are able to be allocated into three major categories: (i) in-depth, (ii) interception, and (iii) expert interviews (Kent, 1999; Kotler, 2002; Kotler and Keller, 2006; Kent, 2007; Kolb, 2008; Wilson, 2012; and Belk, 2013).

Moreover, as previously construed (and/or constructed) in Research Design and Methodology (chapter four), every research method and strategy is used for exploratory, descriptive, and explanatory research studies (Yin, 2009; and 2014). Some of these clearly belong to the deductive approach, others to the inductive approach. Correspondingly, this study is deductive since it has already had the research philosophy including the approaches of PPP/BOT, SD/SEM, and SQ/SA as well as qualitative research study.

This section generates the “Model Verification and Validation (V&V)” through the technique of qualitative methods. As a consequence, these pieces of information from the interviews of EXAT experts as part of the major stakeholders could merely support and answer the research questions, aim with its objectives, and the SEM model. The model Verification and Validation (V&V) is derived from and authorised by the interviews of EXAT experts who are part of the key stakeholders (AIAA, 1988; LANL, 2004; and Pace, 2004).

Before delineating the approach of qualitative techniques by the expert interviews in this research study, two keywords need to be defined.

Firstly, the connotation of "**verification**" is the act of showing or checking that something is true, accurate, correct, or definite. Its synonym is ***confirmation.*** Additionally, verification establishes the truth of the correspondence between a product/service and its specification. This interpretation is derived from the Latin word, ***"veritas"*** to English word, ***"truth"*** as well as from the Latin word, ***"verificare"*** to English word, ***"verify"*** (The Oxford Advanced Learner's Dictionary, 2016; AIAA, 1988; Boehm, 1984; LANL, 2004; and Pace, 2004).

Secondly, **"validation"** is the act of (i) proving that something is true or correct, (ii) making something legally valid, and/or (iii) stating officially that something is useful and of an acceptable standard. In addition, validation establishes the fitness or worth of a product/service for its operational mission. This translation is developed from the Latin word, ***"valere"*** to English word, ***"strong/worthy"*** as well as from the Latin word, ***"validus"*** to English word, ***"valid"*** (The Oxford Advanced Learner's Dictionary, 2016; AIAA, 1988; Boehm, 1984; LANL, 2004; and Pace, 2004).

Lastly, the crucial word "verification" is similar to "do the thing right" or "efficiency" whilst "validation" is comparable to "do the right thing" or "effectiveness".

Model Verification and Validation (V&V) through the (Senior) Expert Interviews

Firstly, in accordance with marketing research studies as well as research designs of qualitative, quantitative, and mixed methods, the expert interview approaches have subsequently been achieved in the final steps of research in order to reinforce information and the research outcomes (Kent, 1999; Kotler, 2002; Kotler and Keller, 2006; Kent, 2007; Kolb, 2008; Wilson, 2012; and Belk, 2013).

Next, this thesis develops the research strategies in terms of marketing, case study, and SEM as the unique mixed methods research design. All of the analysed outcomes contain the final models of SEM path diagrams as shown in Figure 7.1 and Appendix D. These analytical strategies are vital to the interviews and the reviews of experts as part of the qualitative approach. Not only are they expert in terms of modelling stakeholder satisfaction with transportation PPP projects, but some of them are also the senior experts

in PPP transportation infrastructure development. These (senior) expert interviews were conducted between 1st and 9th February 2015, after deriving factors and assessing the overall fit of the model. The same questionnaire used to survey the EXAT users and officials is implemented as guidelines of the factors (variables) in this research study for the interviews and the reviews. Nevertheless, not every expert answered each question in the questionnaire. When interviewing and reviewing the consequences and models, all of them considered the outcomes and path diagrams with path analysis as well as straight arrows with the dotted arrow rather than merely concentrating on the general questions. Almost every expert mentioned that even though they have had experience in construction engineering infrastructure projects for decades, they have never seen and thought of a model representing the scopes and features of work experience as in this model.

In summary, every expert is **satisfied** with all of the results **except** SQ3_1 (sufficient expressway networks) and SQ3_6 (VMS is beneficial) where they foresee the necessity for extended network systems and greater Information Technology (IT) to be implemented. They are also interested in the SEM diagrams with each path analysis. All of them totally agreed with the results and the model with the dotted arrows (which demonstrates the dynamics of cause and effect on factors SQ, PV, SA, and BI).

Furthermore, their ideas are **supportive** and **productive** of the model and the four factors as **"an exemplary model"**. It can be claimed that the finalised model is **verified** and **validated** by means of the interviews and reviews of these experts. The model is believed to be a **valid model** (base model) to identify and evaluate the benefits associated with PPP projects in Thailand and/or other developing countries.

Lastly, this is the final part of research strategies in order to fulfil the terms of "Modelling User Satisfaction with Transportation Public-Private Partnership Projects". Their points of view neither conflict with the research findings nor with the views of each expert. The assessments of the experts are constructive and effective. Furthermore, research findings have been approved for publication since the experts are both stakeholders and policy makers. The names and positions of the nine experts are listed as follows, as are their comments regarding Model Verification and Validation (V&V).

1. Mr Noppon Pokee works for the Expressway Authority of Thailand (EXAT), Ministry of Transport (MOT). Mr Pokee is an engineer in

Transport System Research and Development (R&D) Section, Office of Expressway System Engineering R&D. He mentioned that his position involves dealing with IT (Information Technology) and ITS (Intelligent Transportation Systems) for transport system research and development, EXAT. Thus, Mr Pokee stated that VMS (Variable Message Signs) would be more effective if the VMS could be associated with the model, IT, and ITS implemented in terms of SQ (service, safety, and operation) factors. In this research study, VMS (SQ3_6) is part of SQ3 (Operation Factors). From this point of view, he is interested in the model to continue to develop to fit in the VMS in the real situation. Additionally, in the view of Mr Noppon Pokee, this model is valid as the exemplification of sustainable research and development in the EXAT organisation.

2. Dr Sakda Panwai is the Director of the Office of Expressway System Engineering R&D, EXAT, MOT. Dr Panwai is also the Research Collaborator on Doctoral Thesis on User Satisfaction with Public-Private Partnership Transportation Projects (as mentioned in Appendix B). His areas of interest cover Transport Engineering, Intelligent Transportation Systems, and Strategic Management and Marketing. When reviewing the model, he discovered that this model is very interesting and it is imperative that the model is related to EXAT's vision, "Worthwhile choice, advance development and to be aware of the environment" and the mission in forms of SQ, PV, SA, and BI. It is also mentioned that this SEM model can fit in to other general PPP projects. In conclusion, Dr Panwai established that *"This model is effective; it can be a valid model. Not every engineer is able to generate and develop a model such as this, and not every marketer can do so either"*.

3. Mr Aiyanat Tinapai was appointed the EXAT Governor and a member and secretary of EXAT's Board of Directors. With his position in top level management (governor) in the EXAT organisation, Mr Tinapai is willing to serve the public according to the EXAT motto, vision, mission, corporate goals, core values, and strategies. In summary, Mr Aiyanat Tinapai verified and validated the model and remarked that this model

functions as a story teller of the EXAT. An organisation which publicising everything including the lifestyle of members of staff to serve EXAT users twenty four (24) hours a day. In considering this SEM model, he commented that it is more helpful to look at the diagram rather than reading an executive summary and explaining it in the form of an A4 essay.

4. Mr Kamol Mantham works for the Department of Highways (DOH), Ministry of Transport (MOT). At the moment, he works for the DOH and MOT as the Deputy Director-General (Operations) with special responsibility for engineering and operations management in the department and ministry. This means that Mr Mantham is on duty as a senior engineer and serves his department and ministry in terms of operations management including (PPP) transportation infrastructure development. He agrees with the model especially SQ3 as the operation factors connecting with other SQ factors to PV and SA then leading to BI. In conclusion, Mr Kamol Mantham ascertained that this model can be utilised and even adapted for use with other organisations.

5. Mr Chusak Gaywee is the Director-General of DOH and a member of EXAT's Board of Directors as the Member Representing Ministry of Transport. Previously, he was the Deputy Permanent Secretary of MOT. His areas of interest and experiences are engaging with transportation projects and infrastructure development including transportation PPP projects. When the model is viewed and reviewed, Mr Gaywee agreed with its form and direction. He took the view that not only may this SEM model be used for the EXAT organisation, but it may also be implemented in other organisations such as the DOH. To summarise, Mr Chusak Gaywee believed that this model will be able to be adapted and applied as a valid model for the DOH and MOT as a policy framework in the future.

6. Mr Surachet Sangchayosawat is the Strategy and Planning Director, Bangkok Mass Transit System Public Company Limited (BTSC). Previously, he was the manager of Co-ordination Division, Strategy and

Planning Department. It is cited that there is a correlation between EXAT and BTS case study research. The BTS SkyTrain has been located in locations that are satisfying to almost every passenger (BTSC, 2016). By implementing the pivotal network associated with other transportation infrastructure networks, the passengers can find ease in transferring to other transport systems conveniently and comfortably. The commitment of the BTSC to public services is to operate the greater access systems for every passenger. The commitments are comprised of the three key factors of service, safety, and operation. After considering the final diagram, Mr Sangchayosawat agreed that its use would be important for use within BTSC.

7. Mr Udon Yimyong has worked for the Major Cineplex Group Public Company Limited since 2002. This company is the largest operator of cinemas in Thailand (Major Cineplex, 2016). His position is area manager and he manages numerous branches of the Major Cineplex cinemas including the Paragon Cineplex which is Thailand's largest multiplex at Siam Paragon (Major Cineplex, 2016; and Siam Paragon, 2016). Formerly, he was also the manager at the Paragon Cineplex. The areas of work and interest of Mr Yimyong cover service management involving service quality and service operations as well as strategic marketing management with planning and organising. Due to his position with his direct experiences and inter-personal skills, Mr Yimyong has established his experiences since he has met numerous customers in various situations and circumstances. When being interviewed, he was interested in the A4 (one page) questionnaire with the questions. As a result, Mr Yimyong mentioned that it would be advantageous for the cinemas to conduct such a research survey. When reviewing the model, he agreed with the model notably SQ1 (service factors) and SQ3 (operation factors) associated with PV to SA then leading to BI. In conclusion, Mr Udon Yimyong wholeheartedly endorses that this model can be employed even for marketing research studies such as this in his cinemas.

8. Mr Suphoth Sublom is the former Permanent Secretary of MOT. He used to be the Director-General of DOH and the member of EXAT's Board of Directors as well. Mr Sublom has served the MOT for over four decades. As a consequence, his high level of the knowledge and skill in cases of strategic planning, construction, engineering, infrastructure, and management is significant to evaluate the model. He validated this model and highlighted Service Quality (SQ). He was especially interested in the issues of service, safety and operation i.e. SQ1, SQ2, and SQ3. In addition, Mr Sublom paid particular attention to the enforcement and SQ3 (operation factors) comprehending the VMS (SQ3_6) which is able to link SQ2 (safety factors). The relationship between SQ and BI via PV and/or SA is also valid.

9. Mr Chaisawasd Kittipornpaiboon is the Director of Council of Engineers (COE) as well as the former Permanent Secretary of MOT. Previously, he was also the Director-General of DOH and a member of EXAT's Board of Directors as the Member Representing Ministry of Transport. He has experience in transportation infrastructure development for more than forty five years. As a result, Mr Kittipornpaiboon is able to verify and validate this model as a valid (base) model. He observed that the three primary factors (SQ) found on Service (SQ1), Safety (SQ2) and Operation (SQ3) correspond to PV and SA especially SQ3_6 (VMS is beneficial) effectively. Hence, the SQ accomplishes Behaviour Intentions (BI) by passing via Perceived Value (PV) and/or Satisfaction (SA) such as ***"Mission Accomplished"***. Furthermore, in his view, the model is vital for stating the policy framework in the future of DOH and/or MOT.

The goal of this research is to answer the research questions, and meet the aim, and objectives of (i) Modelling; (ii) User Satisfaction; with (iii) Transportation Public-Private Partnership Projects. As already stated, the research findings have been verified and validated by these experts.

An applied philosophical research framework has been utilised. This was developed from existing literature reviews in order to empirically develop, verify, and validate the best

practice model for the government policy framework. As a result, the consequences of this research study are found and formed as an analysed model constructing the four principle factors (SQ, PV, SA, and BI). The technique of "Model Verification and Validation (V&V)" through the expert interviews and reviews is then finalised in order to finalise this SEM model as a valid model. Not only is this model developed for the EXAT research study, it can also identify and evaluate the benefits associated with other PPP projects.

7.9 The Value and Potential Application of the Developed Model

As formerly expressed, this chapter introduced of the approaches of SEM which explicates the SEM including other technical issues involved during the interview sections. The statistically advanced technique adapted for data collection and analysis is also outlined. A description of selected stakeholders follows before a discussion of the interview findings. A cross analysis of the findings of the key stakeholders, along with their answers to the questionnaire survey is presented.

Furthermore, quantitative research methods have been conducted in order to measure and model the perceived satisfaction of EXAT users and officials. The results relate to the expectation criteria which the users perceive the EXAT facilities to be. These include Service Quality (SQ), Perceived Value (PV), Satisfaction (SA), and Behaviour Intentions (BI). Qualitative approaches have also been employed as part of research designs to qualify a verified and validated model as a valid model (base model). Hence, it is vital to discuss the value and potential application of the developed model as explicated below:

First of all, this model is related to the EXAT vision and mission in forms of SQ, PV, SA, and BI. It can be established that the model is effective; it can be a valid model. It is remarked that the model is the story teller explaining everything including EXAT staff's lifestyle to serve EXAT users twenty four (24) hours a day. When considering this SEM model, it is more valid than reading an executive summary and explaining it in the form of an A4 essay.

Next, it can be agreed with the SEM diagram that it is important and appropriate for developing and employing this valid model to BTS projects in the future. It would also be possible for the cinemas to conduct such as a research survey. When reviewing the

model, this model can be employed even for marketing research studies such as this in other areas including BTS SkyTrain and cinemas.

It can also be indicated that the three primary factors based on Service (SQ1), Safety (SQ2), and Operation (SQ3) correspond to Service Quality (SQ) and SQ affects Behaviour Intentions (BI) via Perceived Value (PV) and/or Satisfaction (SA). It is related to the EXAT vision and mission as well as "Mission Accomplished". Furthermore, the model is ready for stating the policy framework in the future of MOT.

The last and most critical point can be found that not only is the research study able to meet the research aim and objectives, the research findings are also imperative to achieve the EXAT vision, mission, corporate goals, core values, and strategies as delineated in section 3.5 The Background of the Expressway Authority of Thailand (EXAT).

The vision and mission of EXAT are relevantly interrelated with the vision and mission of MOT as demarcated in Transportation Public-Private Partnership (PPP) Projects in Thailand (3.3) in Chapter Three.

Furthermore, the visions and missions of EXAT and MOT are significantly relevant to the vision of the Kingdom of Thailand, *"Stability, Prosperity, and Sustainability"* (MOT, 2016).

7.10 Chapter Summary

To summarise, the key term "Service Quality" is called SQ. The SQ factors of EXAT questionnaire is related to SQ1 as Service Factors, SQ2 as Safety Factors, and SQ3 as operation Factors. The three factors of SQ are relevant to the model based on data from the preceding case study research adapted from Tangkitsiri and Ogunlana (2004) and Tangkitsiri *et al.* (2013a). Additionally, there are links between the SQ factors and scale dimensions based on the five principal dimensions found by Parasuraman *et al.* (1988) and Zeithaml *et al.* (1990). A model in this research study can be generated and associated with the development as well as the Verification and Validation (V&V) model procedures for the proposed framework. This includes the study of the conceptual framework of the research model as well.

All six SEM hypotheses were analysed by the Linear Structural RELationships (LISREL) programme and the result of the SEM hypotheses is acceptable, valid, and reliable. The summary of testing concludes that almost every hypothesis is supported, yet only one hypothesis did not support the path analysis from SQ to PV. This means that SQ is not able to lead to BI directly, yet it can occur effectively in BI via either PV or SA.

Likewise, the outcomes of the SEM present the three primary factors (Service, Safety, and Operation) corresponding to Service Quality (SQ) and SQ affects Behaviour Intentions (BI) via Perceived Value (PV) and/or Satisfaction (SA). The verified and validated model is generated and developed by using the data from the BTS and EXAT projects as well as ascertained by the experts in cases of reviewing and interviewing. In other words, Structural Equation Modelling (SEM) is also generated on EXAT users in order to develop the model for assessing the satisfaction of users conforming to the research aim and objective (1.5) in this thesis.

Lastly, this is to fulfil the terms of "**Modelling** User Satisfaction with Transportation Public-Private Partnership Projects" as it is the title of this thesis, to answer the research questions and to achieve the aim and objectives of the thesis. The next chapter outlines the major findings of the research.

CHAPTER EIGHT
CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

The final chapter summarises the findings from this innovative research on the specific aims and objectives of the research study. This reflects on the research findings to present a discussion that engages the research questions. In this chapter, it covers how the reviews of the relevance of the published articles to this research as well as the aim and objectives of the study were achieved. Further, these have reflected back on the research process. This means that the chapter of research conclusions and recommendations focuses on the main implications of the study with covering observations including recommendations for further studies are stated in the last chapter.

The chapter contains the seven precise and concise contents and presents a summary of major findings from this innovative research comprising of the achieved aim and objectives in this study. It combines the research findings related to the development of an integrated project evaluation tool for PPP projects as the verified and validated model. This is to fulfil the terms of "Modelling User Satisfaction with Transportation Public-Private Partnership Projects" as it is the object and subject of this thesis as well as to attempt to attain the research questions, aim, and objectives

This chapter concludes the research and elaborates on the achievements of the research aim and objectives. Contributions to the body of knowledge and recommendations for further research are presented later in this chapter. Furthermore, the closing notes of this research are emphasised at the end of the chapter.

8.2 Summary of the Research Study

First of all, this chapter provides conclusions and recommendations based on the analysed results of EXAT users and officials. The numbers of EXAT users and officials replying to the questionnaire are 561 and 52 respectively. The survey questionnaire is designed as a five-point Likert scale ranging from "High Level of Satisfaction (5) to Low Level of

Satisfaction (1)" to ease of rating. The forms of the concise and precise questionnaire are in Thai and English which are depicted in Appendix C. The research consequences stated in Chapter Five Questionnaire Survey Analysis are from 561 EXAT drivers and 52 officials. Then, the path analysis and diagrams are computed by engaging the advanced statistical approach which is the SEM programme as well as verified and validated by the experts (including senior experts) who are the vital stakeholders. Correspondingly, the findings of the model and the interviews with reviews are explicated in Chapter Six Structural Equation Modelling.

These are the techniques of research methods attaining towards the aim for this thesis which is to improve the understanding of **User Satisfaction** with PPP projects with a view to **Improved Customer Satisfaction**. Hence, the models for assessing the satisfaction of stakeholders have been developed and depicted in the Chapters Five and Six. The following objectives are also set for the research:

- To identify and evaluate the benefits associated with PPP projects in Thailand
- To generate a model of User Satisfaction (US) with PPP by using data based on the BTS and EXAT case studies
- To develop a model of User Satisfaction (US) on PPP projects
- To verify and validate the model

The Last and one of the most key elements in this research study is "the research questions". Moreover, these research questions and aim with objectives are found and formed in sections 1.4 and 1.5 of this thesis consecutively. Not only is the achievement of aim and objectives designated in the section 8.4, but the research questions are also answered in the succeeding part as affirmed below:

8.3 Major findings

Major findings extracted from this study are concluded and included in the two main concerns as a philosophical research by means of:

(i) findings from the reviews of relevant articles to the research study constructed on the research questions, aim, and objectives;
(ii) answering the research questions in this thesis.

Findings from the Reviews of the Relevant Articles

The relevant literature, key publications, reliable academic journal materials, and textbooks were reviewed and analysed in order to initiate the philosophical research strategies for the study and to gather understanding of research as well as empirical evidence supporting the research study with the views towards contributing the needed direction and justification for the study. Therefore, a number of findings were described as follows:

1. The conceptual and practical **relationship** between Public-Private Partnership (PPP), Customer Satisfaction (CS), User Satisfaction (US), Marketing and Risk Management were researched to invent an innovative technique to achieve the aim and objectives. There is the **distinctly ambitious** aspiration to improve the comprehension of User Satisfaction (US) with PPP projects in order to improve CS and create the learning laboratory for experimenting with possible options for improving US in the PPP projects. Throughout this research study, System Dynamics (SD) Modelling and Structural Equation Modelling (SEM) have been employed as simulation tools. This means that there are still **knowledge gaps** between **PPP, SD, SEM**, and **CS/US** theoretical approaches which need to be completed, particularly the knowledge of instances of **strategic marketing** (CS) and **transportation engineering** (US) concepts linking and modelling both SD and SEM stimulation techniques in PPP transport projects. Finally, this research has been bridging the gap in the **Academic Knowledge Transfer** between marketing and engineering as well as modelling constructs in terms of SD and SEM.

2. As previously mentioned in ISO 9000:2005, Grenci and Watts (2007), and Tangkitsiri *et al.* (2013b), "**User Satisfaction**" (US) is able to be referred to or defined as "**Customer Satisfaction**" (CS) in the context of this thesis. "**Satisfaction**" is the short form of "User Satisfaction" (US) and "Customer Satisfaction" (CS), and its acronym is "**SA**" in this research. Similarly, in this thesis, the User Satisfaction (US) and/or Satisfaction (SA) is formulated by the following equation:

SATISFACTION = SERVICES – EXPECTATIONS

3. The knowledge of Service Quality (SQ), Perceived Value (PV), and Satisfaction (SA) were deeply explored and to generate an idea to achieve the research questions, aim, and objectives. There is also the **distinct ambition** to the understanding enhancement of PPP stakeholder satisfaction by reviewing relevantly academic literature as the secondary research in forms of strategic research approaches. This secondary research is part of the research design and methodology. This has significantly been relevant to the research study since this thesis has been involved in marketing as part of the Strategic Marketing Management such as SQ, PV, and SA. Therefore, **the relationship between social science/engineering and marketing research studies can be found and formed.** This strategic approach of the research study systematically been undertaken to identify previous research and gaps which needed to be studied and filled. These include generating models of the level of satisfaction.

4. This is an innovatively strategic approach in conducting research studies with providing a mechanism for modelling the **relationship** between "**SQ**" and "**SA**" transferring the academic knowledge from CS to US. This means that there is the "**Academic Knowledge Transfer**" in terms of customers and deliveries of SQ on the side of marketers. The major variables of PV, SQ, and SA have been argued and constructed. The model has initially been constructed as SQ, PV and SA, and then the concluding model consists of Behavioural Intentions. Behavioural Intentions (BI) have been discussed in depth in cases of marketing literature articles. Nonetheless, **few** experimental research **studies** have been established in transport and construction engineering management. In order to comprehend the Behavioural Intentions of public transport, passengers are significant and favourable to Behavioural Intentions (BI). Then, **BI** will **lead** to **Customer Loyalty**. The last and the most important phase is the "Customer Loyalty". This is the essential role for success and survival of the service organisations and companies (Lewis and Booms, 1983; Parasuraman *et al*., 1985; Parasuraman *et al*., 1988; Oliver, 1993; 1999; Wen *et al*., 2005; Joewono and Kubota, 2007; Oliver, 2010; and Sumaedi *et al*., 2012). Furthermore, the nine academic journal articles are relevant to this research study. These are listed in Table 5.1: Modelling Variables in the SEM Research Framework. Five of these academic research studies mentioned above claim that BI is a significant regulating variable which will meaningfully impact on "Customer Loyalty"

through such Service Quality (SQ) factors as Perceived Value (PV) and Satisfaction (SA).

5. According to Oliver (1999) and Parasuraman and Grewal (2000), there have been various research studies conducted which indicated that there have been two further successful achievements which generated and developed customer loyalty. Hence, two of the additional valid and efficient components to create **customer loyalty** are (i) to **satisfy customers** and (ii) to **deliver** exceptional **value** gleaned from either services or products in cases of excellence and quality. There are, in addition, marketing research studies on customer loyalty assessment being based on **the definition of customer loyalty**. According to Hicks *et al*. (2005), it is claimed that assessment of **customer loyalty** is generated (i) by the will and conduct of repurchase; (ii) by the will to introduce or recommend companies to others; (iii) by the establishment of public esteem. Likewise, Lewis and Booms (1983) defined that Service quality is "a measure of how well the service level delivered matches customer expectations. Delivering quality service means conforming to customer expectations on a consistent basis". Marketing researchers as well as managers of service companies and/or organisations concur that Service Quality (SQ) involves a comparison of expectations with performance (Lewis and Booms, 1983; and Parasuraman *et al.*, 1985). As previously stated by Lewis and Booms (1983), it is found and formed that Service Quality is "the measure of how well the service level delivered matches customer expectations since 1983, yet several organisations have unfortunately never considered this issue until now.

6. These are significant to comprehend the elementary aspects of Service Quality (SQ) to measure the quality of service. Initially, the first three well documented characteristics of services developed during the service quality revolution and advocated by Regan (1963) and Parasuraman *et al.* (1985), i.e. intangibility, heterogeneity, and inseparability. This is, then, followed by other key research studies including "**SERVQUAL**: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality" and "Delivering Quality Service: Balancing Customer Perceptions and Expectations" (Parasuraman *et al.*, 1988; and Zeithaml *et al.*, 1990). Both of the research findings are based on five principal dimensions of tangibility, reliability, responsiveness, assurance, and

empathy. Moreover, these dimensions form the basis for the questions contained in this A4 survey questionnaire. This expresses the development of a multiple-item scale for measuring service quality; that is why this instrument is the so-called "SERVQUAL".

7. In order to achieve the targeted vision, strategic operations are essential to be formulated. In terms of operating strategic formulations, both of the external and internal environment assessments have been analysed by using **TOWS** Matrix as a strategic formulation implement. This strategic analysis tool is constructed on SWOT analysis. The difference between TOWS and SWOT is that SWOT emphasises the internal environment whilst **TOWS** highlights the external environment at the practically realistic level. In both matrices, i.e. SWOT or TOWS analyses, the outcomes of the analysis techniques in a TOWS or **SWOT** strategy are **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats. In this context, "strategy" can be defined as the art of determining how it can be won in life and business. In each formulated strategic operation, the strengths and opportunities of the organisation will be considered to formulate the strategic operations in order to strengthen the organisation. Meanwhile, weaknesses and limitations of the organisation will also be considered in order to transform the weaknesses and limitations into strengths in future operations.

Answering the Research Questions in this Thesis

This section reflects on the synthesis of findings on the research aim and objectives to provide the discussion, which directly engage the research questions. It concludes with four interacting questions. The research questions are formulated as follows:

1. Are users satisfied with Public-Private Partnership (PPP) projects? If "yes", how satisfied are they? If "no", why not?
2. Can the level of satisfaction be improved and if so how?
3. What are the real benefits that the users will gain from the PPP projects?
4. Will the projects ensure "reliability of journeys" on the roads? In other words, the more levels of satisfaction there are, the fewer levels of risk there will be.

As a result, the four research questions in this thesis are answered:

1. *Are users satisfied with Public-Private Partnership (PPP) projects? If "yes", how satisfied are they? If "no", why not?*

The EXAT stakeholders are satisfied with the PPP project including the users. These are composed of the users, officials, and experts as well as senior experts. The findings are explicated as follows:

561 EXAT *Users*

From the descriptive analysis in this study, it is discovered that the mean scores for the perceived satisfaction of SQ, PV, SA, and BI are 3.67, 3.67, 3.66, and 3.52 respectively.

52 EXAT *officials*

Equally, it is learnt that the mean scores for the perceived satisfaction of SQ, PV, SA, and BI are 3.88, 4.04, 3.92, and 4.02 respectively.

The Interviews and Reviews of Experts (including Senior Experts)

Almost every (senior) expert mentioned that even though they have experienced in the construction engineering infrastructure projects for decades, they have never seen and thought of a model representing the scopes and features of work experience as in this model. In summary, every (senior) expert is **satisfied** with all of the results **except** SQ3_1 (sufficient expressway networks) and SQ3_6 (VMS is beneficial) where they foresee the necessity for extended network systems and greater Information Technology (IT) to be implemented. They are also interested in the SEM diagrams with each path analysis. All of them have totally agreed with the results and the model with the dotted arrows since they have systematically been concerned with each cause and effect on SQ, PV, SA, and BI.

Furthermore their points of view have accordingly been found that these are **supportive** and **productive** of the reviewed model and four factors as **"an exemplary model"**. It can effectively be claimed that the finalised model is **verified** and **validated** by means of the interviews and reviews of these experts. The model is believed to be a **valid model** (base model) to identify and evaluate

the benefits associated with PPP projects in Thailand and/or other developing countries.

2. Can the level of satisfaction be improved and if so how?

The level of satisfaction can be improved by implementing the SEM **Valid Model** (Base Model) as well as researching and developing the findings of the survey questionnaire. These are constructed on the User Satisfaction (US) equation:

SATISFACTION = SERVICES – EXPECTATIONS

In addition, the outcomes of the level of the user perceived satisfaction in this research study indicate that the lowest Mean scores (M) for the perceived satisfaction of the SQ (Table 6.2) and BI (Table 6.5) are 3.32 (SQ1_4) and 3.08 (BI3) consecutively. The SQ1_4 is "Appropriate Fare"; the BI3 is "Willingness to travel despite fare increases".

As answered earlier, the levels of the SQ1_4 and BI3 satisfaction can be improved by implementing the SEM **Valid Model** (Base Model), researching, and developing the findings of the survey questionnaire. These mean that even though SQ is not able to lead to BI directly, it can occur effectively in BI via either PV or SA. There is the link between SQ1_4 and BI3 in cases of the fare which can be solved by the policy framework directed by the EXAT's Board of Directors.

In terms of the review and interview by experts including senior experts, every (senior) expert is **satisfied** with all of the results **except** SQ3_1 (sufficient expressway networks) and SQ3_6 (VMS is beneficial) where they foresee the necessity for extended network systems and greater Information Technology (IT) to be implemented. They are also interested in the SEM diagrams with each path analysis. All of them have totally agreed with the results and the model with the dotted arrows since they have systematically been concerned with each cause and effect on SQ, PV, SA, and BI.

3. What are the real benefits that the users will gain from the PPP projects?

In measuring and modelling levels of perceived satisfaction of EXAT users and officials, quantitative research methods have been used. Due to the commercial nature of the transportation PPP infrastructure projects adopting the PPP method, user satisfaction is a

crucial cause for concern. The results relate to expectation criteria which the users perceive the EXAT facilities as Service Quality (SQ), Perceived Value (PV), Satisfaction (SA), and Behaviour Intentions (BI). **These factors convey the real benefits for users.**

In other words, the real benefits that the users will gain from the PPP projects are "**Fulfilment** and/or **Contentment**" as well as "**Reliability of Journeys**".

4. *Will the projects ensure "reliability of journeys" on the roads? In other words, the more levels of satisfaction there are, the fewer levels of risk there will be.*

The projects will ensure the "reliability of journeys" on the roads since the projects have avoided the risk and/or minimised the level of the risk. The projects have investigated and/or evaluated the stakeholders especially the users of the projects in order to measure and perceive the levels of risk. Meanwhile, the projects are able to level and maintain the perceived satisfaction of the users by employing the **Model** (Valid/Base Model). The organisations have always met the users' needs by conducting the research and development approaches. They have to analyse the findings of the survey questionnaire and solve the right issue or problem such as "put the right man, on the right job, at the right time". These are constructed on the User Satisfaction (US) equation and the model as well as it is delineated in **Figure 1.1**

8.4 Achievement of the Aim and Objectives

The overall aim and objectives of this study have formerly been found and formed in the section 1.5 of the Chapter One as well as mentioned in **Summary of the Research Study (7.2)**. This part outlines how the research process addressed the stated aim and objectives of the research study.

Before achieving the aim and objectives, these must initially be represented in this section:

The aim for this thesis is to improve the understanding of **User Satisfaction (US)** with PPP projects with a view to improved **Customer Satisfaction (CS)**. Additionally, models for assessing the satisfaction of stakeholders are developed.

The following objectives have been set for the research:

- To identify and evaluate the benefits associated with PPP projects in Thailand
- To generate a model of User Satisfaction (US) with PPP by using data based on the BTS and EXAT case study researches
- To develop a model of User Satisfaction (US) on PPP projects
- To verify and validate the model

The endeavour of this research is to achieve the aim and objectives to **fulfil** the three terms of (i) Modelling; (ii) User Satisfaction; with (iii) Transportation Public-Private Partnership Projects. Furthermore, the major findings and contributions to knowledge in this research study are acquired and provided to explicate in the subsequent chapters. The findings have also been verified and validated by these experts since their role of stakeholders has been meaningfully enacted as the policy makers which are declared formerly. Similarly, these findings have also adapted and applied philosophical research framework aspects. These are established from existing literature reviews in order to empirically develop, verify, and validate the best practice model for the government policy framework.

In this research study, it is definitely shown that the key stakeholders (users, officials, and experts) are satisfied with its PPP projects/facilities including the EXAT services. The 561 EXAT *users* and 52 EXAT *officials* from this questionnaire survey as part of the quantitative approach are satisfied with the EXAT facilities. The concise and precise questionnaire is designed as a five-point Likert scale ranging from "High Level of Satisfaction (5) to Low Level of Satisfaction (1)" to ease of rating.

Stating to the aim and objectives of this research, an effort to minimise the knowledge gap between public and private sectors in PPP projects has been made. Moreover, an integration of System Dynamics (SD) and Structural Equation Modelling (SEM) concepts as well as project management implementation has been employed. An SD model has been generated and developed as a methodology and mathematical modelling scheme for discussing complicated subjects (Sterman, 2000; Che *et al*., 2010; and Xu *et al.*, 2012). In order for research data to be of value and of use, then, the analysed data and model must be both reliable and valid in terms of the reliability and validity of content with modelling. Moreover, section 5.2 in Chapter Five delineates the construction of the model to determine the extent of perceived satisfaction.

A comparison between the outcomes of the research and the proposed aim and objectives has been achieved. This means that research findings from this case study interview and review are developed and expected to accomplish a valid (base) model. This means that a hypothesised classification of the categorical variables has been established and developed since both of the key literature review and significant resolution factors have been reached and determined after consideration (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al*., 2010; Schumacker and Lomax, 2010; and Byrne, 2012). Finally, the model can be a valid model by the PPP experts in terms of Verification and Validation (V&V).

The BTS SkyTrain project was selected as the case study to acquire the valid model even though the research work is still at an initial stage of development. Then, an SEM model has been developed and analysed as the advanced statistical theory designed to examine a theoretical model (Byrne, 1998; Byrne, 2001; Byrne, 2010; Hair *et al.*, 2010; Schumacker and Lomax, 2010; and Byrne, 2012). The EXAT project was chosen as the case study to achieve the verified and validated model of user satisfaction on PPP projects.

The Quantitative research methods are developed collected and analysed in order to evaluate and obtain the SQ elements of EXAT users who perceive value and are satisfied with EXAT projects and its officials. This means that the mixed methods apply to conduct the two significant types of the outlined research studies, and the process of analysing the qualitative and quantitative data is explicated. In conducting primary research to achieve the research aim and objectives, expert interviews are investigated to explore the strategy of the EXAT and its behaviour towards the levels of perceived satisfaction. Likewise, the BTS and EXAT case study researches are considered and modelled as the valid model (base model). Finally, the verified and validated model is generated and developed by using the data from the BTS and EXAT projects. As such, the model is believed to be a valid model (base model) to identify and evaluate the benefits associated with PPP projects in Thailand and/or other developing countries.

8.5 Contributions to Knowledge

This is an innovatively strategic approach in conducting research studies with providing a mechanism for modelling the relationship between “Service Quality” and “Satisfaction” transferring academic knowledge from marketing, Customer Satisfaction (CS) to engineering, User Satisfaction (US). The variables of Perceived Value (PV), Service

Quality (SQ) and Satisfaction (SA) have been argued and constructed. The model has initially been constructed as SQ, PV and SA, and then the concluding model consists of Behavioural Intentions. Whereas, behavioural intentions (BI) have been discussed in depth in cases of marketing literature, yet few studies have been established in transport and construction engineering management (Parasuraman *et al.,* 1985; Parasuraman *et al.,* 1988; Oliver, 1993; 1999; Wen *et al.,* 2005; Joewono and Kubota, 2007; Oliver, 2010; and Sumaedi *et al.,* 2012)

Value of the findings

There is empirical knowledge to support the research gap between government authority and private sectors in terms of Public-Private Partnership (PPP) and evaluating PPP projects can be minimised by linking model indicators, risk management, and level of satisfaction with the integrated projects as the evaluation tool which is verified and validated by the experts.

This thesis provided the key significant contributions to knowledge. This section presents the practical and theoretical implications of the study as follows:

Originality of the Research Study

The area of research study which principally emphases on "Modelling User Satisfaction with Transportation Public-Private Partnership Projects". This is the public transport that has been discussed numerous times. Nonetheless, the problems related to the road users in Thailand have never been discussed by implementing (i) a valid model and (ii) an academic knowledge transfer from marketing to engineering. This is the most important gap in the body of knowledge, and the present researchers have tried to figure out this gap. Lastly, this research study has been bridged the gap in knowledge transfer between marketing and engineering as well as the modelling constructs in terms of SD and SEM.

Contributions to Knowledge

Every project tends to be implemented in order to achieve certain intended benefits. Sometimes the intended target groups have not been satisfied with the output or outcome from such projects. Perceptions of the real benefits (e.g. reduced travel time and cost, fuel saving, safety, and reliability) may not comply with the intended benefits and stakeholders may face risks in terms of services at the same time. Nonetheless, there will normally be room for improvement on current projects as well as lessons to be learned

for future projects. The policy makers are able to, as a result, focus their attention on those aspects in which the project is performing below the expected level and reduce its risks.

First of all, the research studies have contributed from marketing principle in terms of Service Quality (SQ or SERVQUAL) and Customer Satisfaction (CS) to the construction engineering management theory. This means that it has been done by transferring the knowledge from (strategic) marketing, i.e. Consumer/Customer Satisfaction (CS) to (transportation) engineering, i.e. Road User Satisfaction (US).

Similarly, this has applied theoretical framework aspects established from existing literature review in order to empirically develop, verify, and validate the best practice model for the government policy framework.

Next, the study compliments the existing body of knowledge based on customer loyalty theory by providing empirical insight into key features of the concept from Service Quality (SQ) including Perceived Value (PV) and Customer Satisfaction (CS) to Behavioural Intentions (BI) as mentioned in the five chapters, i.e. Chapter Two, Chapter Three, Chapter Four, Chapter Five, and Chapter Seven. This is the way to identify and understand **Road User Satisfaction**. Then, a generated idea linking between the Public-Private Partnership (PPP) concepts, Customer Satisfaction (CS) approaches, and both of System Dynamics (SD) and Structural Equation Modelling (SEM) theories were established. Hence, the quantitative and qualitative approaches have innovatively been employed as part of research designs to qualify a verified and validated model as a valid model (base model).

This model is related to the EXAT vision and mission in forms of SQ, PV, SA, and BI. It can be established that the model is effective; it can be a valid model. It is remarked that the model is the story teller explaining everything including EXAT staff's lifestyle to serve EXAT users twenty four (24) hours a day. When considering this SEM model, it is more valid than reading an executive summary and explaining it in the form of an A4 essay.

It can be agreed that the SEM diagram is important and appropriate for developing and employing this valid model to BTS projects in the future. It would also be possible for

the cinemas to conduct such a research survey. When reviewing the model, this model can be employed even for marketing research studies such as this in other areas including BTS SkyTrain and cinemas.

It has also be indicated that the three primary factors based on Service (SQ1), Safety (SQ2), and Operation (SQ3) correspond to Service Quality (SQ) and SQ affects Behaviour Intentions (BI) via Perceived Value (PV) and/or Satisfaction (SA). It is related to the EXAT vision and mission as well as "Mission Accomplished". Furthermore, the model is ready for stating the policy framework in the future of MOT.

The last and most critical point can be found that not only is the research study able to meet the research aim and objectives, the research findings are also imperative to achieve EXAT's vision, mission, corporate goals, core values, and strategies as delineated in section 3.5 'The Background of the Expressway Authority of Thailand (EXAT)'.

The vision and mission of EXAT are relevantly interrelated with the vision and mission of MOT as demarcated in Transportation Public-Private Partnership (PPP) Projects in Thailand (3.3) in Chapter Three.

Furthermore, the visions and missions of EXAT and MOT are significantly relevant to the vision of the Kingdom of Thailand, *"Stability, Prosperity, and Sustainability"* (MOT, 2016).

8.6 Recommendations for Further Research Studies

Recommendations for further research studies have been identified during the progress of this research study. The following areas are related and recommended as follows:

1. The major outcome of this research study is to improve the understanding of **User Satisfaction (US)** with PPP projects with a view to improved **Customer Satisfaction (CS)**. Additionally, the models for assessing the satisfaction of stakeholders are developed. As a consequence, the results and the models relate to expectation criteria which the users perceive the EXAT facilities as Service Quality (SQ), Perceived Value (PV), Satisfaction (SA), and Behaviour Intentions (BI). The model has initially been constructed as SQ,

PV and SA, and then the concluding model consists of BI. There are few experimental research studies of BI established in transport and construction engineering management. In order to comprehend the BI of public transport, passengers are significant and favourable to BI. Then, BI will lead to Customer Loyalty. The last and the most important phase is the "Customer Loyalty". This is the essential role for success and survival of the service organisations and companies. This will, however, require more variables (factors) to construct and to design a new form of the questionnaire and model to achieve "Customer Loyalty" factors associated with the previous research studies.

2. This study research focused on only the 4-wheel vehicle category, e.g. personal cars as the major population of EXAT facilities users. There are 6-10 wheel and more than 10 wheel vehicles such as lorries/trucks, articulated lorries/tractor-trailers, and tankers. In this thesis, the keyword "Road Users" is defined as car drivers excluding passengers; on the other hand, sometimes passengers or commuters are particularly relevant and influential notably bosses, wives, or patients.

3. The other major findings of this innovative research are the Variable Message Signs (VMS), Information Technology (IT), and Intelligent Transportation Systems (ITS) factors and their relationship. There is the need to establish how these factors have impacted on the users, officials, and experts including senior experts. VMS would be more effective if the VMS could be associated with the model, IT, and ITS implemented in terms of SQ (service, safety, and operation) factors. In this research study, VMS is part of SQ3 (Operation Factors). From this point of view, it is crucial to continue to develop the model to fit in the VMS in the real situation.

4. According to the BTSC (2016), Tangkitsiri and Ogunlana (2004), and Tangkitsiri *et al.* (2013b), it is cited that the SkyTrain has been in position which is significant and satisfying almost every passenger including foreigners. By implementing the pivotal network associated with other transportation systems, the BTS projects have conducted the questionnaire survey to the local and foreign users and other stakeholders. As a

consequence, the further research studies are able to extend to a study scale of the research measurement in cases of other EXAT stakeholders including foreign users.

8.7 The Closing Notes

According to Saunders *et al. (*2009), it is mentioned that most academic research studies are limited by time constraints. Thus, the scope of this study chiefly emphasises on the "Modelling User Satisfaction with Transportation Public-Private Partnership Projects" as the subject and object of the research to carry out the **understanding** of User Satisfaction (US). Due to the commercial nature of infrastructure projects adopting and applying the PPP approach, user perceived satisfaction is a major cause for concern (Kotler, 2002; Tangkitsiri and Ogunlana, 2004; Kotler and Keller, 2006; and Tangkitsiri *et al.*, 2013b) (Kotler, 2002; Tangkitsiri and Ogunlana, 2004; Kotler and Keller, 2006; and Tangkitsiri *et al.,* 2013b)

In accordance with the scope, the study is confined to the infrastructure approach whilst the private investment is partnering with the public sectors as the concept of Public-Private Partnership (PPP). Therefore, the infrastructure approach is researched to where private investment is involved and where different elements such as construction, operations and maintenance (O&M) are integrated. This research is also defined in the range by indicating the interesting PPP transportation infrastructure projects consisting of the BTS and EXAT projects as the case study researches.

In forms of marketing researches, the strategic marketing studies involved in the primary and secondary researches which are employed in this thesis as well. The methodologies of the primary research are mixed methods which are combined between quantitative and qualitative research approaches. The techniques of the secondary research refer to review as well as to relate to the relevant academic articles.

Similarly, the comprehensive research is reflected by the achievement of the research questions as well as aim and objectives. The satisfaction models are constructed as the object of the study for levelling the perceived satisfaction of the users and officials. In

this research, additionally, the concise and precise questionnaire is designed as the research implement.

In addition, 561 EXAT users and 52 EXAT officials were collected and analysed by statistical software instruments, i.e. Microsoft Excel and Statistical Package for the Social Sciences (SPSS). LInear Structural RELationships (LISREL) is employed to analyse the hypothesised perceived satisfaction model of the EXAT users in order to fulfil the three terms of (i) Modelling; (ii) User Satisfaction; with (iii) Transportation Public-Private Partnership Projects.

Furthermore, the major findings have also been verified and validated by these experts (including senior experts) since their role of stakeholders has been meaningfully enacted as the policy makers which are declared formerly. Correspondingly, these findings have also adapted and applied philosophical research framework aspects. These are established from existing literature reviews in order to empirically develop, verify, and validate the best practice model for the government policy framework.

As a result, the consequences of this research study are found and formed as an analysed model. The researched model is constructed on the four principle factors (SQ, PV, SA, and BI) which are based on the three primary factors (SQ1: Service, SQ2: Safety, and SQ3: Operation) as shown in Appendix D. The technique of "Model Verification and Validation (V&V)" through the (senior) expert interviews and reviews is then finalised in order to consummate this SEM model to be an exemplary model. Not only is this model developed for the EXAT research study, but the model can also identify and evaluate the benefits associated with other PPP projects.

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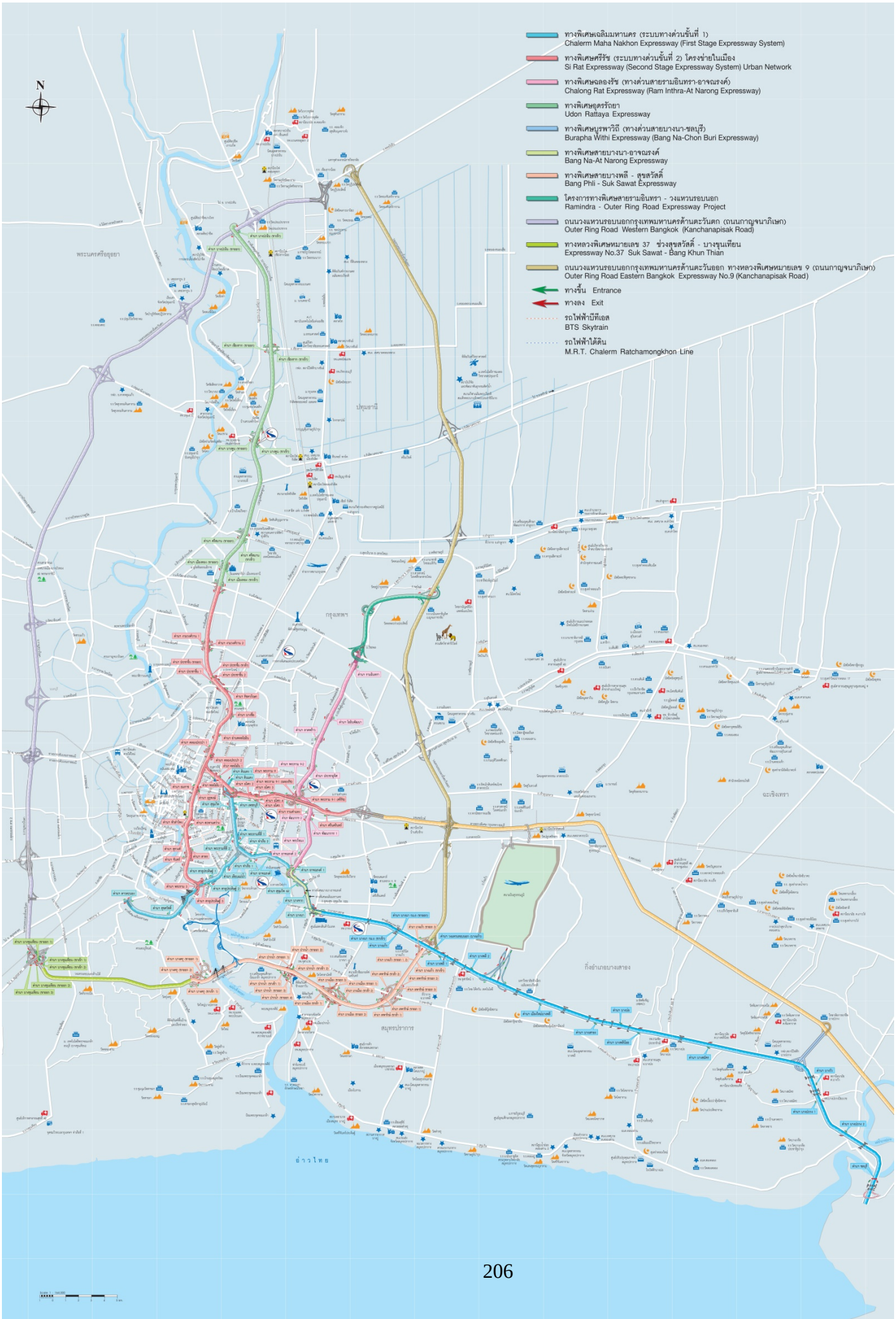
APPENDICES

Appendix A: The Map of EXAT Networks


ทางพิเศษเฉลิมมหานคร (ระบบทางด่วนขั้นที่ 1)
Chalerm Maha Nakhon Expressway (First Stage Expressway System)
ทางพิเศษศรีรัช (ระบบทางด่วนขั้นที่ 2) โครงข่ายในเมือง
Si Rat Expressway (Second Stage Expressway System) Urban Network
ทางพิเศษฉลองรัช (ทางด่วนสายรามอินทรา-อาจณรงค์)
Chalong Rat Expressway (Ram Inthra-At Narong Expressway)
ทางพิเศษอุดรรัถยา
Udon Rattaya Expressway
ทางพิเศษบูรพาวิถี (ทางด่วนสายบางนา-ชลบุรี)
Burapha Withi Expressway (Bang Na-Chon Buri Expressway)
ทางพิเศษสายบางนา-อาจณรงค์
Bang Na-At Narong Expressway
ทางพิเศษสายบางพลี - สุขสวัสดิ์
Bang Phli - Suk Sawat Expressway
โครงการทางพิเศษสายรามอินทรา - วงแหวนรอบนอก
Ramindra - Outer Ring Road Expressway Project
ถนนวงแหวนรอบนอกกรุงเทพมหานครด้านตะวันตก (ถนนกาญจนาภิเษก)
Outer Ring Road Western Bangkok (Kanchanapisak Road)
ทางหลวงพิเศษหมายเลข 37 ช่วงสุขสวัสดิ์ - บางขุนเทียน
Expressway No.37 Suk Sawat - Bang Khun Thian
ถนนวงแหวนรอบนอกกรุงเทพมหานครด้านตะวันออก ทางหลวงพิเศษหมายเลข 9 (ถนนกาญจนาภิเษก)
Outer Ring Road Eastern Bangkok Expressway No.9 (Kanchanapisak Road)
ทางขึ้น Entrance
ทางลง Exit
รถไฟฟ้าบีทีเอส
BTS Skytrain
รถไฟฟ้าใต้ดิน
M.R.T. Chalerm Ratchamongkhon Line
N
พระนครศรีอยุธยา
ปทุมธานี
กรุงเทพฯ
ฉะเชิงเทรา
สมุทรปราการ
อ่าวไทย

Appendix B: The Letter from SBE (EGIS) to EXAT

HERIOT WATT UNIVERSITY

Dr. Sakda Panwai
Director
Office of Express System Engineering Research and Development
Expressway Authority of Thailand
Bangkok

25 October, 2013

Dear Dr. Panwai

Research Collaborator on Doctoral Thesis on Stakeholder Satisfaction with Public-Private Partnership Transportation Projects

On behalf of the School of the Built Environment, I write to invite you as Research Collaborator on Mr. Worapong Tangkitsiri's (Yod) doctoral degree work on Public-Private Partnership Transportation Projects. To fulfil the requirements for the doctoral degree, Yod needs to collect data on EXAT projects. Your role will be to direct him on how best to go about collecting the data and to facilitate access to information and information gate-keepers within and outside EXAT that may be useful for the research work to be successful.

In line with our research practice, we promise that any information supplied will be used strictly for research purposes only and that the information will be used in accordance with our research ethics guidelines (attached for information). We will also involve you in any publications from the work as co-author, as much as it is appropriate. Your role as Research Collaborator will be acknowledged in the final thesis.

Thank you for consenting to serve as Research Collaborator on Yod's thesis.

Kind regards,

Professor Lynne Jack

Director of Research

Institute for Building and Urban Design

School of the Built Environment
Edwin Chadwick Building Gait 4 Heriot-Watt University Edinburgh EH14 4AS United Kingdom
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Edinburgh Campus • *Scottish Borders Campus* • *Orkney Campus* • *Dubai Campus*
Heriot-Watt University is a Charity registered in Scotland, SC000278

Appendix C: The A4 Survey Questionnaire Forms in Thai and English

ระดับความคิดเห็นในการใช้บริการของการทางพิเศษแห่งประเทศไทย (กทพ.)

โปรดใส่เครื่องหมายถูก (✓) ลงใน ☐ และ เติมคำในช่องว่าง

1. เพศ ☐ หญิง ☐ ชาย ☐ ไม่ระบุ
2. อายุ ☐ 18-35 ปี ☐ 36-50 ปี ☐ 51-60 ปี ☐ มากกว่า 60 ปี
3. อาชีพ ☐ นักเรียน/นักศึกษา ☐ ข้าราชการ ☐ พนักงานเอกชน ☐ ธุรกิจส่วนตัว ☐ อื่นๆ โปรดระบุ .....
4. รายได้ต่อเดือน ☐ น้อยกว่า 15,000 บาท ☐ 15,001-25,000 บาท ☐ 25,001-50,000 บาท ☐ มากกว่า 50,000 บาท
5. จุดประสงค์ที่ใช้ทางพิเศษ (ตอบได้มากกว่า 1 ข้อ)
   ☐ ไปเรียนหรือทำงาน ☐ กลับบ้าน ☐ ซื้อของ ☐ ติดต่อธุรกิจ ☐ อื่นๆ โปรดระบุ .....
6. ใน 1 สัปดาห์ ใช้ทางพิเศษจำนวน .....ครั้งต่อสัปดาห์
7. ด่านทางพิเศษที่ใช้เป็นประจำ 1. ..... 2. ..... 3. .....
8. วิธีการชำระเงิน ☐ เงินสด ☐ อีซี่พาส (Easy Pass) ☐ อื่นๆ โปรดระบุ .....

	จากประสบการณ์ ท่านมีความคิดเห็นอย่างไร ในการเดินทาง โดยทางพิเศษ	เห็นด้วยมากที่สุด	ระดับความคิดเห็น			เห็นด้วยน้อยที่สุด
		5	4	3	2	1
ด้านบริการ	การใช้ทางพิเศษ มีความสะดวกสบาย					
	ขั้นตอนการใช้บริการ ทางพิเศษ รวมถึงอีซี่พาส (Easy Pass) มีความรวดเร็ว					
	ระยะเวลาที่ใช้ ในการเดินทาง โดยทางพิเศษ รวดเร็วกว่า เส้นทางอื่น					
	อัตราค่าผ่านทาง มีความเหมาะสม					
	มีความมั่นใจ ในการใช้ทางพิเศษ เนื่องจากบนทางพิเศษ มีโทรศัพท์ฉุกเฉิน ที่ติดตั้งทุก 1 กม.					
	มีความมั่นใจ ในการเดินทาง เนื่องจากมีบริการช่วยเหลือ เมื่อเกิดเหตุฉุกเฉิน โดยไม่เสียค่าใช้จ่าย					
	ระดับความพึงพอใจโดยรวม ด้านบริการ ☐ มากที่สุด ☐ มาก ☐ ปานกลาง ☐ น้อย ☐ น้อยที่สุด					
ด้านความปลอดภัย	มีความมั่นใจ ที่มีโทรทัศน์วงจรปิด (CCTV) เพื่อตรวจสภาพจราจร และเหตุการณ์บนทางพิเศษ					
	ป้ายสัญญาณ ในการแสดงสัญญาณเจราจร มีเพียงพอ					
	ป้ายสัญญาณ ในการแสดงสัญญาณเจราจร มีความชัดเจน					
	ทางแยก บนทางพิเศษ มีความปลอดภัย					
	ทางขึ้น-ลง ทางพิเศษ มีความปลอดภัย					
	มีความมั่นใจ ด้านความปลอดภัย ในการขับขี่					
	ระดับความพึงพอใจโดยรวม ด้านความปลอดภัย ☐ มากที่สุด ☐ มาก ☐ ปานกลาง ☐ น้อย ☐ น้อยที่สุด					
ด้านการปฏิบัติการ	ทางพิเศษครอบคลุมพื้นที่ที่ต้องการเดินทาง					
	ระบบการเก็บค่าผ่านทาง รวมถึงอีซี่พาส (Easy Pass) มีประสิทธิภาพ					
	การจัดการจราจรมีความคล่องตัว					
	ทางพิเศษมีความสะอาด					
	การเดินทางด้วยทางพิเศษ สามารถคาดการณ์เวลา ที่ใช้ในการเดินทางได้แน่นอน					
	ป้าย (ไฟวิ่ง) ประชาสัมพันธ์ ที่ติดตั้งบนทางพิเศษ เป็นประโยชน์ต่อการตัดสินใจในการเดินทาง					
	ระดับความพึงพอใจโดยรวม ด้านการปฏิบัติการ ☐ มากที่สุด ☐ มาก ☐ ปานกลาง ☐ น้อย ☐ น้อยที่สุด					
ด้านอื่นๆ	การใช้ทางพิเศษ คุ้มค่ากับเงินที่จ่ายไป					
	การใช้ทางพิเศษ ช่วยประหยัดเวลาในการเดินทาง					
	การใช้ทางพิเศษ ทำให้คุณภาพชีวิตดีขึ้น					
	ยินดีที่จะใช้บริการทางพิเศษต่อไป					
	จะแนะนำการใช้ทางพิเศษให้กับผู้อื่น					
	เต็มใจที่จะจ่าย แม้อัตราค่าผ่านทางเพิ่มขึ้น					
ระดับความพึงพอใจโดยรวม ในการใช้ทางพิเศษ ☐ มากที่สุด ☐ มาก ☐ ปานกลาง ☐ น้อย ☐ น้อยที่สุด						

This survey is used for PhD research by Worapong Tangkitsiri (wt89@hw.ac.uk;+447594554459), School of the Built Environment, Heriot-Watt University. Supervised by Prof Stephen Ogunlana and Dr Adekunle Oyegoke. It aims to improve the understanding of stakeholder satisfaction with a view to improve user satisfaction. This research has been approved by the relevant Ethics Committee and it is completely anonymous and confidential.

"Level of Satisfaction with the Expressway Authority of Thailand (EXAT) services"

Please mark ☑ in the appropriate boxes and fill in the blanks.

1. Gender ☐ Female ☐ Male ☐ Prefer not to say

2. Age (years) ☐ 18 – 35 ☐ 36 – 50 ☐ 51 – 60 ☐ Older than 60

3. Occupation ☐ Student ☐ Government Officer ☐ Company Employee ☐ Business Person ☐ Other.....

4. Monthly Income (Baht) ☐ Less than 15,000 ☐ 15,001-25,000 ☐ 25,001-50,000 ☐ More than 50,000

5. The main purpose for using the EXAT services *(Please mark as many as apply)*
☐ To study / work ☐ To go home ☐ To go shopping ☐ To do business ☐ Other.....

6. In one week, you travel by expressways ..... time(s) *(Please specify)*

7. The expressway toll(s) *you use frequently 1. ..... 2. ..... 3. ..... (Please specify)*

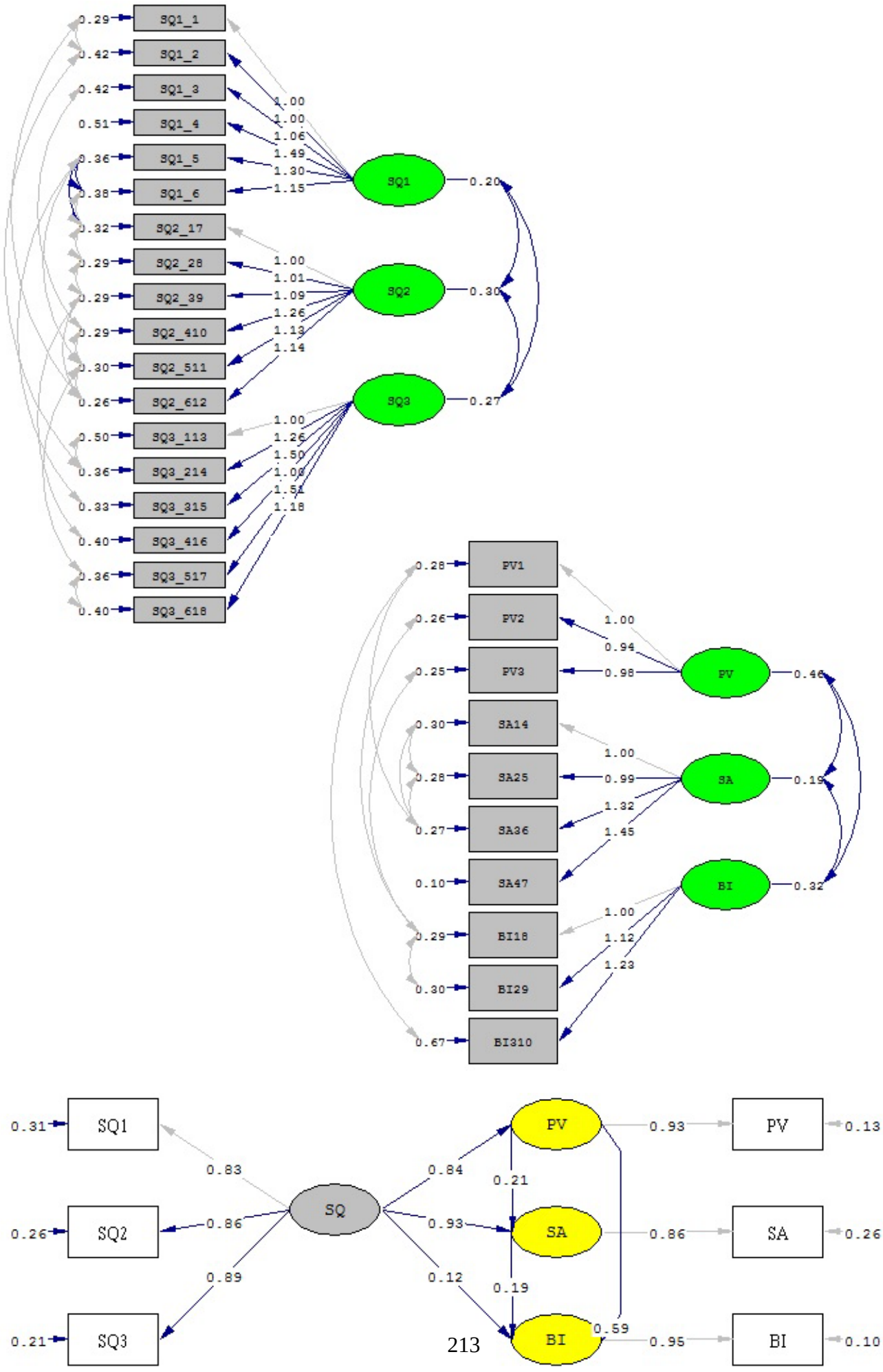
8. Payment ☐ Cash ☐ Easy Pass ☐ Other.....

	Based on your experience, what is your opinion regarding expressway travel?	The Most Perceived Satisfaction The Least				
		5	4	3	2	1
1. Service Factors	The convenience of using the expressway					
	Quickness in passing through the pay station(s) (including Easy Pass)					
	Short travel time on expressways relative to other routes					
	Appropriate Fare					
	Good feeling using the expressway because emergency phones are installed at every 1 km on the expressway					
	Confidence in using the expressway due to free accident services					
	Overall Satisfaction with Service Factors					
2. Safety Factors	Confidence due to closed-circuit television (CCTV) monitoring traffic conditions and incidents on the expressway					
	The sufficiency of traffic signs to display traffic signals					
	The clarity of traffic signs to display traffic signals					
	The safety of junctions on expressways					
	The safety of expressway ramps connecting to non-express roads					
	Feeling of safety whilst driving on the expressways					
	Overall Satisfaction with Safety Factors					
3. Operation Factors	Sufficient networking of expressways					
	Efficiency of toll collection systems (including Easy Pass)					
	Traffic management					
	The cleanliness of expressways					
	The predictability of travel time					
	Information regarding traffic conditions & significant events through variable message signs (VMS) is beneficial					
	Overall Satisfaction with Operation Factors					
4. Other Factors	Value for money					
	Saving travel time					
	Improving the quality of the traveller's life					
	Willingness to use the expressways frequently					
	Willingness to recommend the EXAT (facilities) to other people					
	Willingness to travel despite fare increases					
	Overall Satisfaction with expressways					

This survey is used for PhD research by Worapong Tangkitsiri (wt89@hw.ac.uk;+447594554459), School of the Built Environment, Heriot-Watt University. Supervised by Prof Stephen Ogunlana & Dr Adekunle Oyegoke.

It aims to improve the understanding of stakeholder satisfaction with a view to improve user satisfaction. This research has been approved by the relevant Ethics Committee and it is completely anonymous and confidential.

Appendix D: Path Diagrams of the Final Models of SQ, PV, SA, and BI


SQ1_1
SQ1_2
SQ1_3
SQ1_4
SQ1_5
SQ1_6
SQ2_17
SQ2_28
SQ2_39
SQ2_410
SQ2_511
SQ2_612
SQ3_113
SQ3_214
SQ3_315
SQ3_416
SQ3_517
SQ3_618
SQ1
SQ2
SQ3
PV1
PV2
PV3
SA14
SA25
SA36
SA47
BI18
BI29
BI310
PV
SA
BI
SQ1
SQ2
SQ3
SQ
PV
SA
BI

Appendix E: SEM Key Terms

Hair *et al*. (2010) reviewed key terms to develop a clarified understanding of the SEM method and its terminology. The key terms could also be applied to generate a particular methodical approach in terms of SEM and a subject of its study. The words of the key terms are in **bold font**. The other points of emphasis in the SEM research and cross-referred key terms are in *italics*. These are described as mentioned below:

Causation Principle by which cause and effect are established between two (*observed/unobserved) variables*. It requires a sufficient degree of association (covariance) between the two variables, that one variable occurs before the other, and that no other reasonable causes for the outcome are present. In its strictest terms causation is rarely found. In practice, however, strong theoretical support can make empirical estimation of causation possible.

Chi-square Statistical measure of difference used to compare the *observed* and *estimated covariance matrices*. Chi-square (χ^2) is the only measure that has a direct statistical test as to its significance. Also, "Chi-square" or "chi" forms the basis for many other *Goodness-Of-Fit (GOF)* measures.

Comparative Fit Index (CFI) An incremental *fit* index that is an improved version of the *Normed Fit Index (NFI)*. The CFI is normed so that values range between 0 and 1, with higher values indicating better f*it*. It is among the most widely used indices. CFI values above 0.90 are usually associated with a model that *fits* well.

Competing model Modelling that compares the proposed *model* with a number of alternative *models* in an effort to validate that no better-fitting model exists. This strategy is mainly and closely appropriate to *structural equation modelling*.

Confirmatory analysis Use of a multivariate technique to test or confirm a pre-specified relationship. For example, it is hypothesised that only two variables should be predictors of a dependent variable. If it is empirically tested for the significance of these two predictors and the non-significance of all others, this test will be a confirmatory analysis. The confirmatory analysis is the opposite of *exploratory analysis*.

Construct *Unobservable* (*unobserved*) or *latent* concept that the researchers can define in conceptual terms but cannot be directly measured or measured without error. A construct can be defined in varying degrees of specificity, ranging from quite narrow concepts to more complex or abstract concepts, such as intelligence or emotions. No matter what its level of specificity, however, a construct cannot be measured directly and perfectly but must be approximately measured by multiple *indicators*.

Construct validity Extent to which a set of *measured variables* actually represent the theoretical *latent construct* they are designed to measure.

Degrees of freedom (df) The number of bits of information available to estimate the sampling distribution of the data after all model parameters have been estimated. In *SEM models*, degrees of freedom are the number of nonredundant covariances/correlations (moments) in the input matrix minus the number of estimated coefficients. The researchers attempt to maximise the degrees of freedom available while still obtaining the best-fitting model. Each estimated coefficient "uses up" a degree of freedom. A *model* can never estimate more coefficients than the number of nonredundant correlations or covariances, meaning that zero is the lower bound for the degrees of freedom for any *model*.

Dependence relationship A regression type of relationship represented by a one-headed arrow flowing from an independent variable or *construct* to a dependent variable or *construct*. Typical dependence relationships in *SEM* connect *constructs* to *measured variables* and predictor (*exogenous*) *constructs* to outcome (*endogenous*) *constructs*.

Effect size Estimate of the degree to which the phenomenon being studied (e.g. correlation or difference in means) exists in the population.

Endogenous constructs *Latent*, multi-item equivalent to dependent *variables*. An endogenous construct is represented by a *variate* of dependent variables. In terms of a *path diagram*, one or more arrows lead into the endogenous construct**.**

Estimated covariance matrix Covariance matrix composed of the predicted covariances between all *indicator* variables involved in a(n) SEM based on the equations that represent the hypothesised model.

Exogenous constructs *Latent*, multi-item equivalent of independent *variables*. They are *constructs* determined by factors outside of the model.

Exploratory analysis Analysis defining possible relationships in only the most general form and then allowing the multivariate technique to reveal the relationship(s). Researchers do not direct to affirm any relationships specified prior to the analysis, yet the researchers authorise the method with the data define the nature of the relationships instead. An example is "stepwise multiple regression" which is a statistical method/model selecting a subset of effects for a regression model in a series of the steps rather than continuously. Thus, the technique enhances predictor variables until some criteria are met. The exploratory analysis is the opposite of *confirmatory analysis*.

Factor See *latent construct*.

Fit See *goodness-of-fit*.

Goodness-Of-Fit (GOF) Measure indicating how well a specified model reproduces the covariance matrix among the *indicator* variables.

Indicator *Observed variable* or *observed value* (also called a *manifest* or *measured variable*) used as a measure of a *latent construct* that cannot be measured directly. The researchers must specify which indicators are associated with each latent construct.

Latent construct *Operationalising a construct* in *structural equation modelling* (*SEM*). A latent construct cannot be measured directly but can be represented or measured by one or more *observed variables* (*indicators*). In combination, the answers to these questions give a reasonably accurate measure of the latent construct (attitude) for an individual.

Latent factor See *latent construct*.

Latent variable See *latent construct*.

LISREL Most generally employed SEM programme. The name of LISREL is derived from **LI**near **S**tructural **REL**ations.

LISREL notation A commonly applied statistical *theory* of expressing *SEM models* and results as a series of matrices employed by *LISREL*.

Manifest variable See *measured variable*.

Measured variable *Observed* (measured) *value* for a specific item or question, obtained either from respondents in response to questions (as in a questionnaire) or from some type of observation. Measured variables are used as the *indicators* of *latent constructs*. Same as *manifest variable*.

Measurement error Degree to which the variables can be measured and imperfectly described the *latent construct(s)* of interest sources of measurement error can range from simple data entry errors to definition of *constructs* that are not perfectly defined by any set of *measured variables*. For all practical purposes, all *constructs* have some measurement error, even with the best *indicator variables*. However, the researchers' objectives are to minimise the amount of measurement error. *SEM* can take measurement error into account in order to provide more accurate estimates of the relationships between *constructs*.

Measurement model A *SEM model* that (1) specifies the *indicators* for each *construct* and (2) enables an assessment of *construct validity*. The first of the two major steps in a complete *structural model* analysis.

Model Representing and operationalising a *theory*. A conventional model in *SEM* terminology consists of two parts:

1. The *measurement model*. This represents the *theory* demonstrating how *measured variables* come together to represent *constructs*.

2. The *structural model*. This illustrates how constructs are associated with each other, often with multiple dependence relationships.

The model can be formalised in a *path diagram*.

Model development strategy *Structural model* strategy integrating *model respecification* as a hypothetically driven technique of improving a cautiously specified *model*. It supports exploration of alternative *model* constructions that may be held in position by *theory*. An elementary *model* structure is recommended and the defined goal of the modelling effort is to develop this structure through modifications of the *structural* and/or *measurement models*. The modified *model* would be verified and validated with the data.

Model respecification Modification of an existing *model* with estimated parameters to correct for inappropriate parameters encountered in the estimation process or to create a *competing model* for comparison.

Normed Fit Index (NFI) One of the original incremental *fit* indices. It is a ratio of the difference in the χ^2 value for the *fitted* model and a null model divided by the χ^2 value for the null model. It ranges between 0 and 1, and a model with perfect *fit* would produce an NFI of 1. One disadvantage is models that are more complex will necessarily have higher index values and artificially inflate the estimate of model *fit*. As a result, it is employed less today in relation to either of the following incremental *fit* measures.

Observed covariance matrix Typical input matrix for SEM estimation composed of the observed variances and covariances for each *measured variable*.

Observed value See *measured variable*.

Observed variable See *measured variable*.

Operationalising a construct Key process in the *measurement model* involving determination of the *measured variables* that will represent a *construct* and the way in which they will be measured.

Path analysis General term for an approach that employs simple bivariate correlations to estimate relationships in a(n) *SEM model*. Path analysis seeks to determine the strength of the paths shown in *path diagrams*.

Path diagram A visual representation of a *model* and the complete set of relationships among the model's *constructs*. *Dependence relationships* are depicted by straight arrows, with the arrow deriving from the predictor variable and the arrowhead pointing to the dependent *construct* or *variable*. Curved arrows represent correlations between *constructs* or *indicators*, but no *causation* is implied.

Reliability Measure of the degree to which a set of *indicators* of a *latent construct* internally relies on their measurements. The indicators of highly consistent *constructs* are extremely and closely connected and affect each other. This can designate that all of them appear to measure the same thing. The individual item reliability can be calculated as 1.0 minus the *measurement error*. It is also remarked that high reliability does not guarantee that a *construct* is a representative of what it is hypothetical to signify. It is essential, yet it is not necessary for condition in terms of *validity*. In simpler words, reliability is a necessary but insufficient condition for *validity*.

RMSEA **R**oot **M**ean **S**quare **E**rror of **A**pproximation One of the most widely used measures that attempts to correct for the tendency of the χ^2 *GOF* test statistic to reject models with a large sample or a large number of observed variables is the root mean square error of approximation (RMSEA). Thus, it better represents how well a model fits a population, not just a sample used for estimation. It explicitly tries to correct for both model complexity and sample size by including each in its computation. Lower RMSEA values indicate better fit. Consequently, it can be reported that the RMSEA is between 0.03 and 0.08. It would be better if the RMSEA was between 0.03 and 0.05.

SEM See *Structural Equation Modelling*.

Structural Equation Modelling Multivariate technique combining aspects of factor analysis and multiple regression that enables the researchers to simultaneously examine a series of interrelated *dependence relationships* among the *measured*

variables and *latent constructs (variates)* as well as between several other *latent constructs.*

Structural model Set of one or more *dependence relationships* linking the hypothesised model's *constructs*. The structural model is most useful in representing the interrelationships of *(observed* and/or *unobserved) variables* between *constructs*.

Theory A systematic set of relationships providing a consistent and comprehensive explanation of phenomena. In practice, a theory is a researcher's attempt to specify the entire set of *dependence relationships* explaining a particular set of outcomes. A theory may be based on ideas generated from one or more of three principal sources: (1) prior empirical research; (2) past experiences and observations of actual behaviour, attitudes, or other phenomena; and (3) other theories that provide a perspective for analysis.

Unobservable value See *latent construct*.

Unobservable variable See *latent construct*.

Unobserved value See *latent construct*.

Unobserved variable See *latent construct*.

Validity referring to the credibility *or* believability of the *SEM* research. Validity of a measure is the degree to which the variable measures what it is intended to measure. A valid measure is reliable, yet a reliable measure is not necessarily valid.

Variate A linear combination of *measured variables* that represents a *latent construct*.

Thank YOU and Thank GOD for giving US a great CHANCE to have this happen on Earth.
According to ACTS 20:35, “it is more blessed to give than to receive”,
and ACT 24/7, “it is also more blessed to give than to forgive”.
We are deeply thankful to God for His Love, Guidance, and Provision.